CHARACTERIZATION OF STREAM FISH ASSEMBLAGES IN SELECTED REGIONS OF MOUNTAIN TOP REMOVAL/VALLEY FILL COAL MINING
(Order no. 1P-0130-NAEX)

TASK 4: PROJECT COMPLETION REPORT

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EXECUTIVE SUMMARY

In West Virginia, mountain top removal/valley fill coal mining targets coal that overlays the Kanawha Formation and the Allegheny Formation found in Lincoln, Wayne, Mingo, Logan, Boone, Wyoming, Raleigh, Kanawha, Fayette, Nicholas, Clay, Webster, and Braxton counties (Fedorko and Blake 1998). Green et al. (2000) provides an overview of the potentially affected watersheds. This type of mining also takes place in the adjacent areas of Kentucky (Howard et al. 2000). Because there is little historical information regarding stream fish populations in the primary region of mountain top removal/valley fill coal mining, the U.S. Fish and Wildlife Service requested that we sample the fish communities at several pre-selected sample sites. The objectives of this study were to 1) characterize the fish communities that exist in the primary region of mountain top removal/valley fill coal mining in West Virginia and Kentucky, 2) determine if any unique fish populations exist in this area, and 3) evaluate the effects of these mining operations on fish populations residing in downstream areas.

During 1999-2000, fish assemblages were sampled in 58 sites in West Virginia located on 1st through 5th order streams, and in 15 sites in Kentucky located on 2nd, 3rd, and 4th order streams (Table 1). The majority of the sample sites were selected in consultation with personnel from U.S. Environmental Protection Agency (USEPA) Region III and Region IV. A few sites were added in the field to enhance the characterization of the fish communities in the primary region of mountain top removal/valley fill coal mining. Sites in West Virginia were assigned an EIS Classification based on U.S. EPA Region III (Green et al. 2000) classification. Sites in Kentucky were assigned an EIS Classification based on Region IV (Howard et al. 2000) classifications. Two sites, a 2nd order in the Island Creek watershed (stations 6) and a 4th order stream in the Mud River watershed (station 22) were sampled during Fall 1999 and Spring 2000, and we determined that collections at these sites were comparable between seasons. However, results from the 1999-2000 sampling effort indicated that not enough reference sites were included to adequately assess the potential effects of mountain top mining/valley fill operations on fish communities in the area. A strong relationship exists between stream size (as described by stream order) and the total number of fish species present (Figure 4). All of

the unmined sites that were to serve as reference sites were located on 1st and 2nd order streams, while sites classified as mined, filled, filled/residential, and mined/residential occurred primarily on 3rd and 4th order streams making direct comparisons between mined and filled sites difficult (Figure 4). As a result, in Fall 2001, eight sites in the Mud River that were classified as filled or filled/residential were re-sampled along with five sites in the Big Ugly and three sites in the Buffalo Creek drainages that were chosen to serve as reference (of the unmined condition) sites in the Guyandotte River system.

At each site, a section of stream was selected for sampling the fish community. The length of the study reach was at least 40 times the stream width, but no longer than 150m (Lyons 1992). We collected fishes making three passes (depletion sampling) with a backpack electrofishing unit. Fishes were preserved in 10% formalin and transferred to the Pennsylvania State University Fish Museum for permanent storage in 50% isopropanol.

Fifty-six species, including two hybrid sunfishes, were collected from the 73 sites in the primary region of mountain top removal/valley fill coal mining in West Virginia and Kentucky and the five sites in the Big Ugly drainage (Table 4). As small headwater streams that harbor founding populations that were derived by stream captures have the greatest potential for the progression from a local deme (interbreeding population) to subspecies/species, we examined *Cottus* populations to look for evidence of speciation. An undescribed Potomac River form closely related to *Cottus cognatus* has been collected in West Virginia (R. L. Raesly, pers. comm.) and an undescribed form endemic to the Bluestone River is expected to occur within the state (Stauffer et al. 1995). Our analysis of *Cottus* populations in this area determined that unique species were not present in the study area. However, elimination of these populations would interrupt selective processes that may in turn result in speciation.

Six sites in West Virginia failed to produce any fish (Table 5). Three of these site were in the unmined category (stations 2, 24, 46), one site was in the mined category (station 31), one site was in the filled category (station 1), and one site was in the filled/residential category (station 37). Details of each collection including numbers per species caught, abundance estimate (if possible to calculate), total biomass caught, and biomass per square meter per species are available in Appendix B.

Due to the confounding effects of drought, small stream size (low stream order), and human impact on reference sites in West Virginia, we could not compare reference (unmined) sites to filled sites directly during the 1999/2000 sampling season. Thus, we concentrated on Kentucky sites and 2^{nd} order streams in the New River Drainage where we had comparable reference (unmined) and filled sites to determine the effects of mountain top mining/valley fill coal mining. Comparison of unmined sites and filled sites in Kentucky and in 2^{nd} order streams in the New River Drainage indicate that mountain top removal/valley fill coal mining has impacted the condition of streams. In general, the numbers of total species and benthic species were substantially lower in filled sites than in mined sites in both Kentucky and 2^{nd} order streams in the New River Drainage (Figures 5-8).

In 2001, we were able to compare the fish samples taken in the mined sites in the Mud River with reference sites sampled in the Big Ugly Creek drainage. Both the Mud River and Big Ugly Creek watersheds are part of the Guyandotte River system. Both the total number of species and the total number of benthic species were greater in the reference sites (median 17 and 6 respectively) than in the filled sites collected in 2001 (median=8 and 1.5). The total number of species collected during 1999/2000 was considerably higher (median = 12.5) than the total number of species collected at the same sites in 2001 (median 8; Figures 9 & 10). Water chemistry analysis revealed that five of the Mud River sites sampled in 2001 had detectable levels of selenium (9.5 – 31.5 µg/L). Sites that were associated with valley fills and had detectable levels of selenium supported fewer species than sites solely associated with valley fills. Although the medians of total number of species present in both groups were equal (median = 8 in both cases), the range associated with sites that had fills and selenium was lower than sites with fills alone (Figure 11). Total number of species was dramatically lower in both, sites classified as filled that had selenium present (Mann-Whitney U Test P=0.008) and sites classified as filled that did not have selenium present (Mann-Whitney U Test P=0.0179), than in unmined sites (median = 17). Total number of benthic species followed a similar trend (medians: unmined = 6, filled & selenium = 0, filled & no selenium = 3; Figure 12). Clearly, a multiple year collecting regimen is needed to see if there continues to be a decrease in the number of species over time in the sites associated with valley fills. It may be that with continued mining, heavy metals will continue to be released into the system and have adverse impacts on the fauna.

INTRODUCTION

The State of West Virginia encompasses 62,890 km^2 and is drained by over 45,000 km of streams. The diversity and distribution of fishes in West Virginia is intimately related to drainage divides. The Potomac and James rivers drain the Atlantic Slope, while the remainder of the state drains to the Gulf of Mexico via the Ohio and Mississippi rivers. The fauna of all West Virginia systems draining into the greater Ohio River are similar in composition and have an interrelated history. The greater Ohio River drainage is chiefly comprised of the Monongehela, Little Kanawha, Kanawha, Guyandotte, and Big Sandy/Tug Fork rivers. The upper Kanawha (New) River system above the 7.3 m Kanawha Falls has a unique fauna with six endemic species; the bigmouth chub (*Nocomis platyrhynchus*), the New River shiner (*Notropis scabriceps*), the Kanawha minnow (*Phenacobius teretulus*), the candy darter (*Etheostoma osburni*), the Kanawha darter (*Etheostoma kanawhae*), and the Appalachia darter (*Percina gymnocephala*); all but *E. kanawhae* occur in West Virginia. For this reason, the New River is treated separately from the greater Ohio River drainage with respect to fish distribution. In the ichthyological literature, New River refers to all of the Kanawha River drainage above Kanawha Falls. Thus, all the collections that we made in the Gauley River are reported as the New River fauna.

The Mississippi River basin is considered to be the primary center of origin and dispersal of freshwater fishes east of the Rocky Mountains. The ancient Teays system, which headed against the Blue Ridge Mountains of North Carolina and Virginia, was proposed as a major route of dispersal of fishes east to the Atlantic Slope and north to the upper Ohio River system. The Ohio River did not exist prior to the Pleistocene; during the Pliocene, the two major systems in the central Appalachians were the Teays and Pittsburgh rivers. The existing New-Kanawha River system is regarded as a remnant of the upper Teays River. The Pittsburgh River was a southern tributary of an ancestral river that flowed through the region now occupied by Lake Erie, Lake Huron, and St. Lawrence River. The Old Upper Ohio, Monongahela, and Youghiogheny rivers were tributaries of this system. Pleistocene glaciations reorganized the Teays and Pittsburgh river systems into drainages similar to those present today.

Three Atlantic Slope streams competed for drainage west of the Blue Ridge Mountains during the Tertiary Period: 1) the Potomac River, flowing through the gap at Harpers Ferry; 2) Goose Creek, flowing from west of Massanutten Mountain eastward through Manassas Gap to its confluence with the lower Potomac; and 3) the Rockfish River, which drained the southern Shenandoah Valley through Rockfish Gap into the present Rivanna River drainage of the James River (Stauffer et al. 1978). Thompson (1939) suggested that all streams heading on the western side of the Blue Ridge flowed northwest. The Potomac River was the first to breach this divide and diverted many of these streams to the Atlantic Ocean. The Teays River drained the area west of the Blue Ridge, north to Buchanan, Virginia and Highland County, Virginia via the Fincastle River, which headed against the Old South River. The drainage of the latter included parts of the present-day James and Shenandoah rivers. The Old South River was apparently a tributary to the Shenandoah River, which headed farther south than it does today. Biological evidence in support of this is the widespread distribution of the torrent sucker (*Thoburnia rhothoeca*) in the southern Potomac River west of the Blue Ridge and its absence to the east and north. The mountain redbelly dace (*Phoxinus oreas*) is found in the James and Shenandoah rivers but may have been introduced to the Potomac system. The bluehead chub (*Nocomis leptocephalus)* is widely distributed in the New, Roanoke, and James rivers and is known northward from the South Fork of the Shenandoah and the South River of the Rapidan in the Rappahannock drainage. The margined madtom (*Noturus insignis*) also may have entered the Atlantic Slope via a Teays-Roanoke connection.

The Greenbrier (New River Drainage) and Potomac rivers oppose each other on the Allegheny Mountain along the Pocahontas County, West Virginia- Highland County, Virginia and Pocahontas-Pendleton County, West Virginia lines. The divide does not appear to have been breached; however, the East and West forks of the Greenbrier River have captured drainage from the more northern Monongahela system, and this route has apparently served as a major avenue for the dispersal of fishes from the Teays system including the rosyside dace (*Clinostomus funduloides*), the tonguetied minnow (*Exoglossum laurae*), and the sharpnose darter (*Percina oxyrhynchus*).

Some of the strongest evidence for a Greenbrier-Monongahela-Potomac route of fish dispersal illustrated by the distribution of the river chub (*Nocomis micropogon*) and the bigmouth chub (*Nocomis platyrhynchus*). The bigmouth chub is endemic to the New River system; introgression has occurred between it and river chub populations of the upper Monongahela, and genes from the bigmouth chub have been carried into river chub populations of the upper Potomac. Schwartz (1965) gave additional evidence that the greenside darter (*Etheostoma blennioides*) may have followed a similar route. Further evidence of this proposed route includes the presence of the rainbow darter (*Etheostoma caeruleum*) from the South Branch of the Potomac River (Esmond and Stauffer 1983).

Wallace (1973) concluded that silerjaw minnows (*Ericymba buccata*) in the Potomac basin were of a Monongahela drainage origin, and Hocutt et al. (1978) hypothesized that the species may have entered the Monongahela by way of the Greenbrier River. The silverjaw minnow probably entered the Susquehanna and Rappahannock rivers from the Potomac. Other species regarded as having entered the Potomac River through the Monongahela River system include the Ohio logperch (*Percina caprodes caprodes*) and the southern blacknose dace (*Rhinichthys atratulus obtusus*), which are confined to the Potomac on the central Atlantic Slope.

The least brook lamprey (*Lampetra aepyptera*) is a western form that entered Atlantic drainages, first through captures involving the New River system in Virginia, and then via coastal migration prior to the development of the Chesapeake Bay. The fantail darter (*Etheostoma flabellare*) probably migrated to the Atlantic Coast by means of a variety of headwater captures involving the New and Monongahela rivers.

The banded sculpin (*Cottus carolinae*) complex apparently originated in the Tennessee system and subsequently invaded the upper Ohio, New, and Potomac rivers. The Teays was a center of dispersal of the mottled sculpin (*Cottus bairdi*). Robins (1961) recognized the Potomac sculpin (C*ottus girardi*) as once thought to be endemic to the Potomac, derived from primitive *C. carolinae* stock.

The above discussion emphasizes the uniqueness and importance of the study area in the evolution and speciation of North American freshwater fishes. The areas that were studied were important in the radiation of many different fish forms (e.g., the six endemic fishes in the New River drainage). It is important to note that speciation is not a phenomenon that occurred a million, a thousand, or even one hundred years ago and then stopped. It is a dynamic event that continues to occur. Populations located in the periphery of the distribution of a given species represent those groups that will most likely be involved in a speciation event (Mayr and Ashlock 1991). Certainly, small headwater streams that harbor founding populations that were derived by stream captures have the greatest potential for the progression from a local deme (interbreeding population), to subspecies/species. For example, an undescribed Potomac River form closely related to *Cottus cognatus* has been collected in West Virginia (R. L. Raesly, pers. comm.) and an undescribed form endemic to the Bluestone River is expected to occur within the state (Stauffer et al. 1995). Thus, we examined *Cottus* populations to look for evidence of speciation. The burying of these systems essentially eliminates the genetic diversity needed to fuel speciation processes.

Mountain top mining for the most part targets coal that overlays the Kanawha Formation and the Allegheny Formation found in Lincoln, Wayne, Mingo, Logan, Boone, Wyoming, Raleigh, Kanawha, Fayette, Nicholas, Clay, Webster, and Braxton counties (Fedorko and Blake 1998). Green et al. (2000) provides an overview of the potentially affected watersheds; the Mud River and Island Creek watersheds are located in the Guyandotte River Drainage, the Clear Fork and Spruce Fork watersheds are located in the Kanawha River Drainage, and the Twentymile Creek watershed is located in the New River Drainage. Because there is little historical information regarding stream fish populations in the primary region of mountain top removal/valley fill (MTM/VF) coal mining, the U. S. Fish and Wildlife Service requested that we sample the fish communities at several pre-selected sample sites. The objectives of this study were to 1) characterize the fish communities that exist in the primary region of mountain top removal/valley fill coal mining in West Virginia and Kentucky, 2) determine if any unique fish populations exist in this area, and 3) evaluate the effects of these mining operations on fish populations residing in downstream areas.

METHODS

Fish communities were sampled at 58 sites in West Virginia located on 1st through 5th order streams, and in 15 sites in Kentucky located on 2nd through 4th order streams during Fall 1999 and Spring 2000 (Table 1). In general, comparisons between unmined sites and filled sites were confounded by stream size, effects of drought, and a lack of adequate reference (unmined) sites that were not impaired by other human impacts (including residences, trash, driving through streams). In an effort to elucidate the effects of MTM/VF operations, we sampled 16 sites during Fall 2001 in the Guyandotte River Basin, eight in the Mud River, five in the Big Ugly, and three in Buffalo Creek (Table 2).

Sample Site Selection Fall 1999/Spring 2000

The majority of the sample sites visited in Fall 1999/Spring 2000 were selected in consultation with personnel from U.S. Environmental Protection Agency (USEPA) Region III and Region IV. A few sites were added in the field to enhance the characterization of the fish communities in the primary region of mountain top removal mining. Green eta al. (2000) provide a general description of each of the watersheds sampled in West Virginia. Sites in West Virginia were assigned an EIS Classification based on U.S. EPA Region III (Green et al. 2000) classification: "unmined" (EIS Class = 0), "mined" (EIS Class = 1), "filled" (EIS Class = 2), "filled/residential" (EIS Class = 3), and "mined/residential" (EIS Class = 4). Only three sites (stations 16, 21, and 27 in Table 1) that we sampled in West Virginia were classified as "mined/residential" (EIS Class = 4); thus, we dropped this category from our analysis due to limited sample size. Two sites, a 2nd order stream in the Island Creek watershed (stations 6) and a 4th order stream in the Mud River watershed (station 22) were sampled during both the Fall 1999 and Spring 2000 index periods to determine the comparability of samples between index periods.

Fifteen sites in Kentucky were selected and assigned an EIS Classification based on Region IV (B. Berrang and H. Howard, U.S. EPA Region IV, personal communication) classifications; these were classified as either "reference" (EIS Class = 0) or "filled" (EIS Class = 2) (Table 1). Howard et al. (2000) provide a general description of the watersheds sampled in Kentucky. Based on on-site observations, EPA personnel reclassified one site (PSU station 66 – EPA

Station 9 – Lost Creek) as "filled/residential" after sampling was completed (Howard et al. 2000). Howard et al. (2000) removed this site from further analysis as it represented only one site in the filled/residential category. As a result, we removed this site from our analysis as well. Due to differences in site classifications and major drainage differences (Ohio River Drainage in WV vs Cumberland and KentuckyRiver Drainages in Kentucky), we analyzed data from the two regions separately.

Sample Site Selection Fall 2001

In Fall 2001, we selected eight sites in the Mud River that were classified as either "filled" or "filled/residential " in 2nd, 3rd, and 4th order streams for further study (Table 2). In consultation with the USEPA, USFWS, and representatives of the mining companies, we selected sites outside the immediate region of MTM/VF coal mining to serve as reference sites that would characterize the "unmined" condition within the Guyandotte River drainage. Five sites in the Big Ugly watershed (Guyandotte River drainage) and three sites in Buffalo Creek (Guyandotte River drainage) on 2nd, 3rd, and 4th order streams were selected (Table 2). After sampling was completed, J. R. Stauffer was informed that the sites in Buffalo Creek were not good reference sites as they were reported to have been "running orange" earlier in the year (William Booth, caretaker for Chief Logan Park, personal communication). As such, comparisons between sites categorized as "filled" or "filled/residential " and unmined sites are limited to the five reference sites in the Big Ugly watershed.

Characterization of Fish Communities

At each site, a section of stream that included representative habitat types (riffle, pool, and run habitats) was selected for sampling the fish community. The length of the study reach was at least 40 times the stream width, but no longer than 150m (Lyons 1992). In general, fishes were sampled near the location of the EPA benthic macroinvertebrate sampling stations. We did not sample the exact riffle that was designated as the benthic macroinvertebrate site so as not to disturb that site. Thus, the exact sampling reach for fishes is generally located upstream or downstream of the designated EPA site.

Fishes were collected at each site by making three passes using a backpack electrofishing unit. Collections began at the downstream end of the section and proceeded upstream for the entire section. All fishes from the first pass were placed in a bucket labeled "Collection #1." Two additional collections were made in a similar fashion, and fishes placed in buckets labeled "Collection #2" and "Collection #3." Each collection was preserved separately. Fishes were preserved in 10% formalin and transferred to The Pennsylvania State University Fish Museum for permanent storage in 50% isopropanol. Fishes from each sample were identified to species, enumerated, measured (standard length, mm), and weighed (nearest 0.01g). Total biomass caught was determined for each collection as the product of the average weight of the species and the total number caught. Biomass per square meter sampled was determined by dividing total biomass caught by the total surface area sampled (stream section length in meters x average stream width in the section in meters).

Sampling resulted in three separate counts for each species (corresponding to the electrofishing pass number). These counts were used to estimate abundance of each species using the BASIC program, MicroFish (van Deventer and Platts 1983). The program also calculated the 95% confidence interval associated with the estimate. In most cases, it is assumed that the lower confidence limit was equal to the number caught; thus, only the upper 95% confidence limit was reported. Calculation of abundance using this method (depletion sampling) depends on a continuous decrease in numbers caught with each subsequent electrofishing pass. In some cases, we could not calculate an abundance estimate because the species did not exhibit a normal depletion pattern (i.e., numbers did not decrease with increasing number of electrofishing passes), there were too few individuals caught to make an estimate possible, or all individuals were caught in the first pass.

Evaluation of Mining Effects

The number of species for each of the major drainages sampled in West Virginia (i.e., the Guyandotte, Kanawha, and New River Drainages) during Fall 1999/Spring 2000 was plotted against stream order and categorized by EIS class (i.e., unmined, mined, filled, filled/residential, mined/residential). The number of species that we collected was compared to the number of species that would be expected in relatively unimpacted sites based on historical collections in the Guyandotte River (Stauffer et al. 1989) and the Greenbrier River (Hocutt et al. 1978). The purpose of these historical surveys was to describe the fish community in these river systems. As such, sites were extensively sampled using seines until the investigators deemed that further sampling would not add additional species. Although the sampling effort is different between the historical surveys and our current survey, the historical surveys serve as a benchmark for total number of species in the general area of MTM/VF coal mining prior to the development of these operations. The Guyandotte River collections serve as a baseline for fishes collected in the Guyandotte River Drainage (Mud River and Island Creek) and in the Kanawha River Drainage (Spruce Fork and Clear Fork). The Greenbrier River drains into the New River above Kanawha Falls, and fish communities in the system above the falls are generally considered to be similar (Stauffer et al. 1995). Thus, the historical collections in the Greenbrier River serve as a baseline for our collections in the New River Drainage (Twentymile Creek).

The use of particular attributes of a fish community, such as total number of species or total number of benthic species, to evaluate stream condition is becoming widely accepted (e.g., Karr 1981, Leonard and Orth 1986, Ohio EPA 1987, Davis and Simon 1995, Angermeier et al. 2000). A recent study testing the ability of potential metrics based on attributes of the fish community to distinguish between sites of differing quality in Mid-Atlantic Highland streams found that the total number of species present and the total number of benthic species were most consistently related to site quality (Angermeier et al. 2000). In general, the total number of fish species is expected decrease with increasing degradation (Barbour et al. 1999). However, this number will also vary with stream size (generally increases as stream size increases, e.g. Fausch et al. 1984, Messinger and Chambers 2001), so comparisons of condition between EIS classes must be kept within similar stream orders. Benthic species are generally sensitive to degradation resulting from siltation and benthic oxygen depletion because they feed and reproduce in benthic habitats; thus, we expect the total number of benthic species to decrease with increasing degradation (Barbour et al. 1999). Like the total number of species, the total number of benthic species will also vary with stream size and comparisons between EIS classes must be made between sites in similar stream orders. Benthic species included darter (*Etheostoma spp*. and *Percina spp*), sculpin (*Cottus spp*), and madtom (*Noturus spp*) species.

In addition to the effect of stream size (i.e., stream order), major drainage divides also influence attributes of the fish assemblage and comparisons among site classes based on these attributes (Angermeier et al. 2000). As such, all comparisons between EIS classifications (e.g., comparisons between sites classified as unmined and filled) must be limited to similar stream orders within major drainage basins.

To evaluate differences in attributes of the fish community between EIS classes, we used box-and-whisker plots. These plots display the median (solid line in box), the upper (75^{th} percentile) and lower (25^{th} percentile) quartiles (the solid box), the 10^{th} and 90^{th} percentiles (the whiskers), and any outliers of a population of sites. We used the degree of overlap of the attribute ranges to visually assess differences between the EIS classes. The greatest degree of difference is indicated by no overlap of the interquartile ranges. Overlap between the interquartile ranges that excludes the medians indicates the next greatest difference between EIS classes. Extensive overlap of the interquartile range that includes both medians within the overlap indicates little or no difference between EIS classes (Barbour et al. 1999). Where we had a large enough sample size within EIS class ($n>2$), we also calculated the Mann-Whitney U Test probability to test for statistical significance.

Water Chemistry Analysis – Fall 2001

During Fall 2001, we collected water samples at each of the 16 stations where we sampled fish communities. A single water sample was collected at each site (according to directions provided by the EPA) and sent to the Research Environmental & Industrial Consultants, Inc (REIC) for laboratory analysis of total metals (mg/L of aluminum, iron, arsenic, copper, and selenium) and hardness (as mg/L $CaCO_3$). In addition to the water samples, we measured pH and conductivity in-situ using an Oakton pH testr and TDS Testr 20 respectively.

Determination of Unique Populations

Cottus species were analyzed to determine if unique populations existed within the study area. External counts and measurements followed Stauffer (1991) (Table 3A). Except for gill raker meristics, all counts and measurements were made on the left side of the fish. Morphometric values were expressed as percent standard length (SL) or percent head length (HL).

We analyzed the data to determine which populations of *Cottus bairdi* were different from each other. Morphology has always played an important role in the study of the systematics and evolution of organisms. As part of these studies, attempts have been made to qualify and quantify the shape of the organism. Historically, biological shapes have been delineated by a single measurement or a small number of measurements that have been standardized by the use of ratios. The use of ratios is now generally believed to be statistically invalid when delineating among groups (Humphries et al. 1981, Bookstein et al. 1985, Reyment et al. 1984). Morphological data have been analyzed using principal component analysis. The first principal component has been regarded as a size component, while the additional components are considered to be dependent on the shape of the individual. This technique has also been questioned because there is an effect of size on components other than the first one. Consequently, a sheared principal components analysis was developed by Humphries et al. (1981), which restricts the variation due to size to the first component; the subsequent components are strictly shape related.

Differences in body shape were analyzed using sheared principal component analysis of the morphometric data following Stauffer et al. (1997). Pectoral-fin length and pelvic-fin length were not be included in the analysis, as well as any other variables that were influenced by sex and reproductive stage of the fish. Meristic data were analyzed using principal component analysis. The correlation matrix was factored in the calculation of all principal component analyses, while the covariance matrix was factored in the calculation of the sheared principal components. This analysis ordinated factors independently of a main linear ordination (Reyment et al. 1984). Differences among populations were illustrated by plotting either the sheared second or third principal components of the morphometric data against the first principal components of the meristic data. The minimum polygon cluster of *Cottus* with single chin pores were compared to that formed by *Cottus* with double chin pores.

Determination of Nocomis micropogon and N. platyrhynchus

The river chub (*Nocomis micropogon*) and the bigmouth chub (*N. platyrhynchus*) are easily confused. The bigmouth chub is delineated from all other *Nocomis* species based on the tubercle pattern on the head of breeding males. Historically, the river chub (*N. micropogon*) was not believed to inhabit the New River where the bigmouth chub (*N. platyrhynchus*) occurs. However, there were some fishes collected in Twentymile Creek (New River Drainage) that appeared to resemble *N. micropogon*. Not enough males with breeding tubercles were collected to identify these fishes. As a result, we conducted a shape analysis of these specimens (using the same methods as described above for the analysis of *Cottus* spp, but using different counts and measures described in Table 3B and compared them with known populations of *N. micropogon.*

RESULTS

Fifty-six (56) species, including two hybrid sunfishes, were collected from the 73 sites in the primary region of mountain top removal/valley fill coal mining in West Virginia and Kentucky and the five sites in the Big Ugly Creek watershed (Table 4). Information on the distribution, life history, and biology of each of these 56 species can be found in Appendix A.

Characterization of Fish Communities – Fall 1999/Spring 2000

Six sites in West Virginia failed to produce any fish (Table 5). Three of these site were in the unmined category (stations 2, 24, 46), one site was in the mined category (station 31), one site was in the filled category (station 1), and one site was in the filled/residential category (station 37). Details of each collection including numbers per species caught, abundance estimate (if possible to calculate), total biomass caught, and biomass per square meter per species are available in Appendix B.

Guyandotte River Drainage (Mud River and Island Creek). We sampled fishes at 23 stations in the Guyandotte River drainage (Tables 5 & 6). These collections yielded 5,442 fishes distributed among 30 species. In the Guyandotte River drainage, we sampled five 1st order streams, three unmined and two filled. As expected, these 1st order streams yielded low species diversity. One unmined and one filled site yielded no fish at all. The other unmined site yielded two species (*Rhinichthys atratulus*, *Semotilus atromaculatus*). Only one species, *Rhinichthys atratulus,* was collected at two of the filled sites. Biomass/m^2 and number of individuals/m^2 were highest at the unmined site where fish were collected (Station 5; Table 5).

We made fish collections at nine sites in 2nd order streams. We collected between 1-9 species at each of the unmined sites and 1-12 species at the filled sites (Tables 5 & 6). All of the sites yielded fewer species than collected historically in 2nd order streams in the Guyandotte (Figure1). The highest number of individuals per m^2 and the highest biomass per m^2 were collected at Station 12 (MT-14), which was a filled site (Table 5). The high biomass at this site was largely attributable to the high numbers of *Semotilus atromaculatus* and *Lepomis cyanellus* (Table 6); both species are considered tolerant, and the presence of high numbers of these species is considered to be indicative of environmental stresses (Barbour et al. 1999, Messinger and Chambers 2001).

We collected fish at eight sites in 3rd order streams. The collections yielded between 6-20 species (Tables 5 & 6). All of the sites were classified as filled, filled/residential, or mined/residential. Five of the sites produced more species than historically associated with 3rd order streams in the Guyandotte River drainage (Figure 1).

The two 4th order streams sampled were classified as filled/residential and yielded 19 to 20 fish species, which was a higher number of species expected, based on historical records (Figure 1).

Two stations, 6 (2nd order stream) and 22 (4th order stream), were sampled in both Fall 1999 and Spring 2000. At station 6, we caught only two species, *R. atratulus* and *S. atromaculatus,* each season. During spring, we completed only one pass of electrofishing at station 6 because we caught the same two species in the same relative numbers that we had collected in the fall. At station 22, we caught 20 species during each season. Fifteen of the species were represented in both collections, and, in each collection, we caught an additional five different species. Five species, *Notropis photogenis*, *Noturus miurus*, *Lepomis megalotis*, *Micropterus punctulatus*, and *Micropterus salmoides*, were represented by one individual in the fall sample and were absent in the spring sample. In the spring, *Pimephales notatus* (5), *Moxostoma erythrurum* (1), *Ambloplites rupestris* (1), *Percina caprodes* (3), and *Percina maculata* (1) were represented by a few individuals (number in paretheses following species name), and these were not collected in the fall sample. Because the majority of the species were represented in both fall and spring collections, and those that were different were generally represented by only one or a few individuals, we determined that fall and spring samples in this region are comparable.

Kanawha River Drainage (Clear Fork and Spruce Creek watersheds). We sampled fishes at 22 stations in the Kanawha River Drainage (Tables 5 & 7). These collections yielded 3,792 fishes distributed among 30 species. In the Kanawha River drainage, we sampled one site in a 1st order, unmined stream where no fish were collected.

We made fish collections at eight sites in 2nd order streams. The only unmined site yielded 20 *R. atratulus*. Three mined sites were sampled; one yielded no fish and the other two yielded *S. atromaculatus* and *R. atratulus* in low numbers (Table 6). One site sampled was classified as mined/residential and yielded two species, *R. atratulus* and *Cottus bairdi*. Three species were collected at two sites that were classified as filled and one site classified as filled/residential. All of the sites yielded fewer species than collected historically in 2nd order streams in the Guyandotte (Figure 2). As both the Guyandotte River Drainage and the Kanawha River Drainage are part of the Ohio River system, historical collections in the Guyandotte serve as a baseline for fishes collected in the Kanawha River Drainage (Stauffer et al. 1995).

No unmined 3rd order streams were sampled in the Kanawha River drainage. The mined 3rd order streams produced between 2-6 species, and the filled 3rd order streams yielded between 9-14 species (Tables 5 & 7). Samples from sites classified as filled/residential produced between 0-7 species. Two of these sites yielded the highest biomass (station 36 and 39) that was probably due to the very high number of *Cottus bairdi* collected at these stations (327 and 200 respectively; Tables 5 & 7). Most of the sites sampled in 3rd order streams yielded fewer species than collected historically in 3rd order streams in the Guyandotte River drainage (Figure 2). We collected fishes at three 4th and one 5th order streams that were classified as filled/residential and found between 13-20 species at each of these sites (Table 5 & 8).

New River Drainage (Twentymile Creek watershed). We sampled fishes at 13 stations in the New River Drainage (Table 7). These collections yielded 1,963 fishes distributed among 23 species (including one sunfish hybrid). We sampled one 1st order, unmined site that yielded no fishes. We sampled fishes in six 2nd order streams. Four of these sites were unmined and yielded 3 – 6 species. Two were filled sites that yielded 3 species each (Tables 5 & 8). All 2nd order sites yielded fewer fish species than would be expected based on historical data (Figure 3). No unmined sites were sampled in 3rd or 4th order streams. Three of four collections from 3rd order streams in this drainage were at sites classified as filled and yielded between 9-17 species (Table 8). One site on a 3rd order stream was classified as mined. The mined site and two of the filled sites yielded a lower number of species than would be expected based on historical data, while one filled site yielded a comparable number of species (Figure 3). Two sites classified as mined/residential were sampled in 4th order streams yielding 9 – 16 species (Table 8).

Kentucky Sites. We sampled fishes at 15 stations in Kentucky (Tables 5 & 9). These collections yielded 5,354 individuals distributed among 36 species (including one sunfish hybrid). Collections at five reference sites, two on 2nd order streams and three on 3rd order streams, yielded 9-20 species. The filled sites on 2nd and 3rd order streams yielded between 2-14 fish species. Eight species (*Ericymba buccata, Lythrurus ardens, Phoxinus erythrogaster, Lepomis megalotis, Etheostoma nigrum, Etheostoma sagitta, Percina maculata,* and *Percina stictogaster*) were only collected at the reference stations (Table 9). Six of these species are classified as moderately tolerant of environmental stresses (Barbour et al. 1999). Information regarding tolerance was not available for two of these species, *E. sagitta* and *P. stictogaster*. Six species (*Nocomis micropogon, Rhinichthys atratulus, Ameiurus natalis, Noturus miurus, Lepomis cyanellus, Etheostoma variatum*) were found only at filled sites (Table 9). Four of these species, *R. atratulus, A. natalis, L. cyanellus, E. variatum,* are classified as tolerant of environmental stress, while the other two species, *Nocomis micropogon* and *Noturus miurus*, are classified as intolerant of environmental stress (Barbour et al. 1999). One 3rd order stream site was classified as filled/residential and yielded 13 species (station 66), while two 4th order stream sites classified as filled yielded between 7-14 species (stations 59 and 73). These three stations were not considered further in the analysis as there was only one filled/residential site and no reference site on a 4th order stream.

Characterization of Fish Communities – Fall 2001

We sampled fishes at 16 stations in the Guyandotte River Drainage during Fall 2001 (Table 10). Three of these stations (79, 80, and 81) were chosen to serve as reference sites for our Mud River filled and filled/residential sites, but were impacted by other sources of degradation (William Booth, caretaker of Chief Logan Park, personal communication). Thus, results concentrate on 13 sites – five reference sites in the Big Ugly watershed and eight "filled" and "filled/residential " sites in the Mud River; unmined and filled sites were sampled on 2nd, 3rd, and 4th order streams. These collections yielded 2,739 fishes distributed among 35 species (Table 11). Details of each collection including numbers per species caught, abundance estimate (if possible to calculate), total biomass caught, and biomass per square meter per species are available in Appendix C.

In general, sites that were categorized as filled or filled/residential yielded fewer species that unmined sites (Tables 10 & 11). We collected fishes at four stations in 2nd order streams. Two unmined sites yielded 12 and 13 species, while two "filled" sites yielded 2 and 6 species. We sampled five 3rd order streams – one unmined, two filled, and two filled/residential. The unmined site yielded 17 species, while the filled sites only yielded 6 and 9 species. The filled/residential sites yielded 8 and 18 species. We collected fishes at four 4th order sites, two unmined and two filled/residential. The unmined sites yielded 21 and 24 species, while the filled/residential sites yielded only 8 and 12 species. Of interest, we collected *Lepomis cyanellus,* a species often indicative of environmental degradation (Karr 1981, Barbour et al. 1999), at seven of the eight Mud River stations and at none of the reference sites (Table 11).

Evaluation of Effects of Mining

Evaluation of MTM/VF coal mining operations on fish communities in the West Virginia samples collected in Fall 1999/Spring 2000 was confounded by differences in stream order (Figure 4). In general, the total number of species is expected to increase as stream size (measured by stream order) increases (Fausch et al. 1984, Messinger and Chase 2001). In our samples from West Virginia, a significant relationship exists between stream order and the total number of species collected at a particular site ($R^2 = 0.5849$; $P < 0.001$). The fact that unmined sites were only available in 1st and 2nd order streams (Figure 4), limited our ability to compare unmined to filled sites directly in most cases. Second order streams in the New River basin (Twentymile Creek watershed) provided one instance where we had unmined (n=4) and filled (n=2) sites available for a given stream order allowing a direct comparison of the site classes.

Comparisons between unmined and filled site classes were possible for sites sampled in Kentucky because we had unmined sites (n=5) and filled sites (n=7) in both 2nd and 3rd order streams. We sampled two unmined sites (stations 62 and 63) and three filled sites (stations 64, 65, and 68) in 2nd order streams, and we sampled three unmined sites (stations 61, 71, and 72) and four filled sites (stations 60, 67, 69, 70) in 3rd order streams. As we had unmined and mined sites in both stream orders, sites were pooled across stream order by site classification for the analysis. We sampled one site (PSU station 66 – EPA station 9: Lost Creek) that was redefined as a EIS class of filled/residential after Region IV EPA visited the site (Howard et al. 2000). This site was removed from our analysis as it represented only one site in this EIS category. We sampled two sites on 4th order streams that were classified as filled; however, we did not sample any 4th order unmined sites. Because of the strong relationship between stream order and number of species present, the 4th order sites were not included inour analysis, as we did not have an appropriate reference condition (unmined sites) for the comparison.

<u>Kentucky Fish Community Attributes:</u> In general, filled sites (median = 7) had a significantly lower number of total species than the unmined sites (median = 12) in Kentucky (Figure 5; Mann-Whitney U Test, P=0.037). Total number of benthic species was also significantly lower in filled sites (median = 1) than in unmined sites (median = 6; Figure 6; Mann-Whitney U Test, P=0.0059).

<u>Second Order Streams in Twentymile Creek Watershed:</u> In the Twentymile Creek watershed, we were able to sample four unmined sites and two filled sites in 2nd order streams allowing a comparison to be made between EIS classes (Figures 7 & 8). Filled sites on 2nd order streams in Twentymile Creek watershed yielded fewer total species (median = 3) and benthic species (median = 0.5) than unmined sites (median = 5.5 and 2.5 respectively).

Guyandotte River Drainage Comparisons – Fall 2001: We compared the total number of species and total number of benthic species collected at five unmined sites on 2nd, 3rd, and 4th order streams in the Big Ugly watershed with collections from eight sites on 2nd, 3rd, and 4th order streams in the Mud River watershed that were classified either as filled or filled/residential (Figures 9 & 10). Both the total number of species and the total number of benthic species were greater in the unmined sites than in the filled sites (total species: unmined median = 17, filled median = 8, Mann-Whitney U Test P=0.0093; benthic species: unmined median = 6, filled median = 1.5, Mann-Whitney U Test P=0.0088). The total number of species collected at the unmined sites (median = 17) was also greater than the total number of species collected at the same set of Mud River sites (filled and filled/residential) during the Fall 1999/Spring 2000 period (median = 12.5). The total number of species collected at the Mud River sites during Fall 1999/Spring 2000 was considerably higher (median = 12.5) than the total number of species collected during Fall 2001 (median = 8; Figure 9). The same trend holds for the total number of benthic species (Figure 10). The total number of benthic species collected at the unmined sites is greater (median = 6) than the number of benthic species collected in the Mud River during Fall 1999/Spring 2000 (median = 4), but this number is greater than the number of benthic species collected at the same stations in Fall 2001 (median = 1.5).

Water chemistry analysis (see results below) revealed that five of the Mud River sites sampled in Fall 2001 had detectable levels of Selenium (range from 9.5 to 31.5 μg/L). Selenium has been documented to toxic effects on aquatic life (Lemly 1993). In fact, mortality of rainbow trout, chinook salmon, striped bass, and bluegill has been documented at concentrations of selenium ranging from 4 to 10 μg/L (Kennedy et al. 2000). As such, we grouped the Mud River sites according to presence (n=5) or absence (n=3) of selenium and repeated the analysis of total number of species and total number of benthic species (Figures 11 & 12). Sites that were associated with valley fills and had detectable levels of selenium supported fewer species than sites solely associated with valley fills. Although the medians of total number of species present in both groups were equal (median = 8 in both cases), the range associated with sites that had fills and selenium was lower than sites with fills alone (Figure 11). Total number of species was dramatically lower in both, sites classified as filled that had selenium present (Mann-Whitney U Test P=0.008) and sites classified as filled that did not have selenium present (Mann-Whitney U

Test P=0.0179), than in unmined sites (median = 17). Total number of benthic species followed a similar trend (medians: unmined = 6, filled & selenium = 0, filled & no selenium = 3; Figure 12).

Water Chemistry Analysis – Fall 2001

Water chemistry analysis detected selenium in five of the eight sites in the Mud River watershed associated with valley fills (Table 12; original data sheets from REIC are included in Appendix D). Stations 7 (MT-18), 17 (upstream of MT-15), 18 (MT-15), 22 (MT-23), and 23 (MT-17) all had detectable levels of selenium present, while stations 12 (MT-14), 19 (MT-07), and 20 (MT-05) did not. Station 17 (MT-15) also had elevated levels of aluminum (10.4 mg/L), iron (43.6 mg/L), and copper (0.027 mg/L) as compared to the other filled or unmined sites. It is interesting to compare these values to those measured at station 18 which was located upstream of station 17 and upstream of the valley fill above station 17 (i.e., stations 17 and 18 essentially bracket a valley fill with station 18 at the upstream end and station 17 at the downstream end). Levels of all detectable metals were lower at station 18 (upstream of the valley fill) than at station 17 (Table 12).

Like the related benthic macroinvertebrate studies in West Virginia (Green et al. 2000) and Kentucky (Hoke et al. 2000), we found elevated values of conductivity and pH at sites associated with valley fills as compared to the unmined sites (Table 12). Conductivity values at the filled and filled/residential sites in the Mud River watershed ranged from 513 to 2330 µmhos/cm with an average of 1716.5 µmhos/cm. These values are substantially higher than conductivity values at the five unmined sites that ranged from 125 to 210 µmhos/cm with an average of 164.2 µmhos/cm. The range of pH values at sites associated with valley fills was higher (7.3 to 8.3) than the range of pH at the reference sites (7.0 to 7.2).

Analysis of <u>Cottus</u> Populations.

Sculpins identified as *Cottus bairdi* had either one or two central chin pores. The number of central chin pores has been used as a diagnostic character to separate eastern sculpin species. Therefore, a series of counts and measurements (Table 2) were made on the collections of *C. bairdi*. A plot of the sheared second principal component of the morphometric data versus the first principal component of the meristic data demonstrated that there was complete overlap between the clusters formed by those *C. bairdi* with two chin pores and those specimens with a single chin pore (Figure 13). Thus, there were no other morphometric or meristic factors that supported the theory that the number of chin pores was an informative character that separated the two populations. Nevertheless, it is important to continue to tract these populations. Ideally, one would want to conduct a series of behavior observations to determine if individuals with one and two chin pores assortatively mate.

Determination of Nocomis micropogon and N. platyrhynchus

A plot of the sheared second principal component of the morphometric data versus the first principal component of the meristic data demonstrated that there was some minor separation between the clusters formed by those known populations of *N. micropogon* and *N. platyrhynchus* (Figure 14). These data are equivocal; hence we identified all specimens collected in Twentymile Creek as *N. platyrhynchus*, but more analyses of these populations are needed.

DISCUSSION

The primary region of mountain top removal/valley fill coal mining in West Virginia encompasses an important region for fish diversity. The Kanawha River harbors 105 native species, four of which may be introduced, and 11 introduced forms, two of which may be native. No endemic forms are reported from the Kanawha River below the falls. The West Virginia portion of the New River has a depauperate fauna, when compared to the Kanawha River. There are 56 native species, six of which are endemic and 12 of which may be introduced, and 30 introduced species, 18 of which may be native. The relatively high degree of endemism and the reduced number of native species is most likely attributable to the presence of Kanawha Falls, which is a major barrier to fish dispersal. A total of 90 native species (three of which may be introduced – see Stauffer et al. 1995) inhabits the Guyandotte River, and an additional five introduced species are reported.

The uniqueness of this area is further emphasized by the fact that we collected high numbers of *Cottus bairdi* with single chin pores. Although our analysis indicates that *Cottus* with single and double chin pores constitute a single species, the fact that both forms occur in relatively even numbers is unusual. In most places, deviations from the norm, such as a single chin pore versus a double chin pore, are rare in the population. Thus, single chin pore *C. bairdi* may be on a different evolutionary trajectory than those with double chin pores that may ultimately lead to speciation. The continued disruption of streams in the area may eliminate the genetic diversity necessary for this process to continue. Certainly, more observations and studies on these forms is warranted.

Determining the effects of mountain top removal/ valley fill coal mining operations on stream fishes in West Virginia was difficult. In the five watersheds we studied in West Virginia, unmined sites (reference condition) were limited to 1st and 2nd order streams. This was primarily because there were no higher order streams in this area that had not been mined in this manner. Unfortunately, it is clear that these sites do not adequately portray a reference condition – one where fish communities would not be disturbed – for several reasons. First, fish diversity generally increases with increasing stream order (Fausch et al. 1984). Thus, our findings our confounded by stream order – a general increase in the number of species found in filled sites relative to unmined sites is really due to the fact that we sampled filled sites in 2nd through 5th order streams which naturally have a higher diversity of fishes. Second, Green et al. (2000) documented that many unmined sites were affected by the drought of 1999 because they were located on smaller streams that were likely to have no surface water flow during drought conditions. Drought, in and of itself, can act as a major perturbation on fish communities. Although fish may recolonize an area after a drought, it will take several years before the fish community resembles that which was in place before the drought. Certainly, the recolonization rate of fishes is slower than other fauna present in these systems. For example, many aquatic insects have aerial components of their life cycle; thus, water falls, polluted areas, and other obstructions to upstream dispersal are not as effective barriers to recolonization. We have anecdotal information that some of our sites were severely impacted by drought. For example, in a study conducted by the U.S. Fish and Wildlife Service in 1998, researchers recorded finding *Cottus spp*. in benthic invertebrate samples from White Oak Branch (Station 32), an unmined,

2^{nd} order stream (C. Tibbott, U.S. Fish and Wildlife Service, personal communication). When we sampled, in May 2000, we found only one species, *Rhinichthys atratulus.* Because *R. atratulus* inhabits the water column and is typically a headwater species, we would expect that this species would recolonize an area quickly after a drought. Sculpins (*Cottus spp*.), however, are benthic species that typically have a restricted home range. This restricted movement hinders the dispersal rate of these fishes, making it more difficult for them to recolonize an area after a drought. The same study by U.S. Fish and Wildlife Service documented many fishes in the pools of Oldhouse Branch (Station 24), an unmined, 1^{st} order stream (C. Tibbott, U.S. Fish and Wildlife Service, personal communication). When we sampled in May 2000, we found no fish at all. The lack of fish during the spring sampling is most likely due to the effects of the drought in 1999.

As a result, we focused our attention on collections on 2^{nd} order streams in the New River Drainage and on 2^{nd} and 3^{rd} order streams in Kentucky to evaluate the effects of mountain top removal/ valley fill coal mining on fish communities. Comparison of unmined sites and filled sites in Kentucky and in the New River Drainage indicate that mountain top removal/valley fill coal mining has had an effect on the number and composition of the fish communities in these streams. Streams classified as filled had lower numbers of total species and benthic species than unmined streams in both areas.

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Table 1. PSU collection number, PSU station number, stream name, corresponding USEPA MT or Station number where applicable, locality, stream order, EIS Class (0=unmined, 1=mined, 2=filled, 3=filled/residential, 4=mined/residential), sample date, drainage, and USEPA MT Basin for fish collections completed during Fall 1999 and Spring 2000 in the primary region of MTM/VF coal mining in West Virginia and Kentucky.

Collection #	PSU Station Number	Stream Name	EPA MT or Station	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-99-67	1	Hall Fork	MT-57B	of Left Fork of Cow Creek approximately 100 m above confluence with Left Fork	1	2	23 Oct 1999	Guyandotte	Island Creek
JRS-99-69	2	Sang Branch		approximately 100 m upstream of first stream crossing on Sang Branch Road.	1	0	23 Oct 1999	Guyandotte	Island Creek
JRS-00-61	3	Left Fork	MT-58	Left Fork of Cow Creek upstream of Hall Fork	1	2	28 Apr 2000	Guyandotte	Island Creek
JRS-00-62	4	Cow Creek	MT-52	Cow Creek downstream of valley fill	1	2	28 Apr 2000	Guyandotte	Island Creek
JRS-00-67	5	Spring Branch	MT-13	(tributary of Ballard Fork) approximately 500m above mouth	1	0	29 Apr 2000	Guyandotte	Mud River
JRS-99-68 JRS-00-50	6	Left Fork	MT-60	of Cow Creek	2	2	23 Oct 1999 01 Apr 2000	Guyandotte	Island Creek
JRS-00-52	7	Sugartree Branch	MT-18	downstream of grouted spill way	2	2	01 Apr 2000	Guyandotte	Mud River
JRS-00-59	8	Cabin Branch	MT-50	approximately 100m upstream of confluence with Jacks Fork	2	0	28 Apr 2000	Guyandotte	Island Creek
JRS-00-60	9	Left Fork	MT-59	of Cow Creek downstream of Hall Fork	2	2	28 Apr 2000	Guyandotte	Island Creek

Collection #	PSU Station Number	Stream Name	EPA MT or Station	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-00-64	10	Rushpatch Branch	MT-02	approximately 170m above mouth	2	0	29 Apr 2000	Guyandotte	Mud River
JRS-00-65	11	Lukey Fork	MT-03	above 3rd valley fill approximately one mile above mouth	2	0	29 Apr 2000	Guyandotte	Mud River
JRS-00-68	12	Ballard Fork	MT-14	approximately 100m above mouth	2	2	30 Apr 2000	Guyandotte	Mud River
JRS-00-69	13	Cabin Branch	MT-51	approximately 600m upstream of Copperas Mine Fork	2	0	30 Apr 2000	Guyandotte	Island Creek
JRS-00-91	14	Island Creek		just upstream of mouth of Cow Creek	3	3	31 May 2000	Guyandotte	Island Creek
JRS-99-70	15	Cow Creek	MT-55	along Rt 13 approximately 3.3 miles downstream from Mingo-Logan Coal mine	3	3	23 Oct 1999	Guyandotte	Island Creek
JRS-00-53	16	Mud River	MT-01	downstream of Rushpatch Branch	3	4	02 Apr 2000	Guyandotte	Mud River
JRS-00-54	17	Stanley Fork		upstream of valley fill and upstream of (MT-15)	3	2	02 Apr 2000	Guyandotte	Mud River
JRS-00-55	18	Stanley Fork	MT-15	downstream of valley fill, above beaver ponds	3	2	02 Apr 2000	Guyandotte	Mud River
JRS-00-57	19	Mud River	MT-07	upstream of Ballard fork upstream of Bridge	3	3	03 Apr 2000	Guyandotte	Mud River
JRS-00-58	20	Mud River	MT-05	just upstream of Passenger Fork, downstream of Lukey Fork	3	3	03 Apr 2000	Guyandotte	Mud River
JRS-00-66	21	Mud River	MT-04	just upstream of Lukey Fork	3	4	29 Apr 2000	Guyandotte	Mud River

Collection #	PSU Station Number	Stream Name	EPA MT or Station	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-99-76 JRS-00-51	22	Mud River	MT-23	approximately 1800 ft downstream of confluence with Connelly Branch	4	3	25 Oct 1999 01 Apr 2000	Guyandotte	Mud River
JRS-00-56	23	Mud River	MT-17	just upstream of Sugartree Branch	4	3	02 Apr 2000	Guyandotte	Mud River
JRS-00-92	24	Oldhouse Branch	MT-42	of Spruce Fork	1	0	31 May 2000	Kanawha	Spruce Fork
JRS-99-71	25	Rockhouse Creek	MT-25B	approximately 0.5 km above Rock House Creek Lake	2	2	24 Oct 1999	Kanawha	Spruce Fork
JRS-99-80	26	Buffalo Fork	MT-64	of Toney Fork approximately .06 mile above confluence	2	2	30 Oct 1999	Kanawha	Clear Fork
JRS-99-81	27	Ewing Fork	MT-69	at mouth	2	4	30 Oct 1999	Kanawha	Clear Fork
JRS-00-73	28	Toney Fork	MT-70	upstream of mouth of Ewing Fork	2	3	08 May 2000	Kanawha	Clear Fork
JRS-00-76	29	Davis Creek	MT-79	at mouth	2	1	09 May 2000	Kanawha	Clear Fork
JRS-00-79	30	Lem Fork	MT-80	at mouth	2	1	09 May 2000	Kanawha	Clear Fork
JRS-00-80	31	Sycamore Creek	MT-82	bove unnamed tributary above MT-82 near AMD plant	2	1	09 May 2000	Kanawha	Clear Fork
JRS-00-93	32	White Oak Branch	MT-39	of Spruce Fork	2	0	31 May 2000	Kanawha	Spruce Fork
JRS-99-72	33	Beech Creek	MT-32	just downstream of Peats Branch	3	2	24 Oct 1999	Kanawha	Spruce Fork
JRS-99-73	34	Pigeonroost Branch	MT-45	downstream of security gate	3	1	24 Oct 1999	Kanawha	Spruce Fork
JRS-99-78	35	Sycamore Creek		below mouth of Right Fork	3	1	29 Oct 1999	Kanawha	Clear Fork

Collection #	PSU Station Number	Stream Name	EPA MT or Station	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-99-79	36	Toney Fork	MT-62	at Buffalo Fork confluence South East of Clear Fork	3	3	30 Oct 1999	Kanawha	Clear Fork
JRS-99-82	37	Toney Fork	MT-70	approximately 1 km above mouth of Ewing Run	3	3	30 Oct 1999	Kanawha	Clear Fork
JRS-00-70	38	Beech Creek	MT-28	0.9 miles upstream from gate	3	2	30 Apr 2000	Kanawha	Spruce Fork
JRS-00-74	39	Toney Fork	MT-63	above confluence with Buffalo Fork	3	3	08 May 2000	Kanawha	Clear Fork
JRS-00-77	40	Sycamore Creek	MT-85	downstream of Lem Fork	3	1	09 May 2000	Kanawha	Clear Fork
JRS-00-78	41	Sycamore Creek	MT-81	upstream of Lem Fork	3	1	09 May 2000	Kanawha	Clear Fork
JRS-99-74	42	Spruce Fork	MT-40	upstream from Blair Bridge along St Rt 17	4	3	24 Oct 1999	Kanawha	Spruce Fork
JRS-00-71	43	Spruce Fork	MT-46	upstream of Pigeonroost Branch	4	3	01 May 2000	Kanawha	Spruce Fork
JRS-00-72	44	Spruce Fork	MT-47	150m downstream of mouth of Pigeonroost Branch	4	3	01 May 2000	Kanawha	Spruce Fork
JRS-99-75	45	Spruce Fork	MT-48	upstream of bridge in Dobra-starting 80m above bridge	5	3	25 Oct 1999	Kanawha	Spruce Fork
JRS-00-88	46	Laurel Run	MT-93	at confluence with Rader Fork	1	0	11 May 2000	New	Twentymile Creek
JRS-99-86	47	Hughes Fork	MT-98	approximately 500 m above Jim's Hollow	2	2	01 Nov 1999	New	Twentymile Creek
JRS-00-83	48	Twentymile Creek		just upstream of mouth of Rader Fork	3	1	10 May 2000	New	Twentymile Creek
JRS-00-84	49	Neff Fork	MT-87	near mouth	2	2	10 May 2000	New	Twentymile

Collection #	PSU Station Number	Stream Name	EPA MT or Station	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
									Creek
JRS-00-85	50	Neil Branch	MT-95	from mouth to road culvert (40m)	2	0	11 May 2000	New	Twentymile Creek
JRS-00-86	51	Ash Fork		at mouth	2	0	11 May 2000	New	Twentymile Creek
JRS-00-87	52	Rader Fork	MT-91	500 ft upstream of confluence with Neff Fork	2	0	11 May 2000	New	Twentymile Creek
JRS-00-89	53	Rader Fork	MT-94	upstream of confluence with Laurel Run	2	0	11 May 2000	New	Twentymile Creek
JRS-99-84	54	Twentymile Creek		downstream of Ash Fork	3	2	31 Oct 1999	New	Twentymile Creek
JRS-99-85	55	Hughes Fork		below pond	3	2	01 Nov 1999	New	Twentymile Creek
JRS-00-81	56	Rader Fork	MT-86	just 200m upstream of confluence of Twentymile Creek	3	2	10 May 2000	New	Twentymile Creek
JRS-00-82	57	Twentymile Creek		just downstream of mouth of Rader Fork	4	2	10 May 2000	New	Twentymile Creek
JRS-99-83	58	Twentymile Creek		just downstream of Peach Orchard Branch	4	2	31 Oct 1999	New	Twentymile Creek
JRS-00-95	59	Left Fork	8	of Straight Creek at Rt 66 bridge upstream of confluence with Howard Branch	4	2	03 Jun 2000	Cumberland	
JRS-00-96	60	Sims Fork	6	downstream of confluence with Camp Branch	3	2	03 Jun 2000	Cumberland	
JRS-00-97	61	Clear Creek		RT 190 bridge west of Clear Creek Springs, Kentucky Ridge State Forest (reference)	3	0	04 Jun 2000	Cumberland	

Collection #	PSU Station Number	Stream Name	EPA MT or Station	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-00-94	62	Big Double	12	along Big Double Road (FR1501) down dirt road that is 0.9 road miles upstream of RT 66 (reference)	2	0	02 Jun 2000	Kentucky	
JRS-00-98	63	Sugar Creek	13	on FR1500 approximately 1/2 mile above mouth, 0.8 road miles upstream of RT 66 (reference)	2	0	04 Jun 2000	Kentucky	
JRS-00-99	64	Buffalo Creek	3	just upstream of RT 15 bridge along 1096	2	2	04 Jun 2000	NF Kentucky	
JRS-00-100	65	Grapevine Creek	2	upstream of Clear Fork	2	2	05 Jun 2000	NF Kentucky	
JRS-00-101	66	Lost Creek	9	1.8 road miles upstream of RT 15 along 2446	3	3	05 Jun 2000	NF Kentucky	
JRS-00-102	67	Lick Branch	14	of Ball Fork just above mouth	3	2	05 Jun 2000	NF Kentucky	
JRS-00-103	68	Fugate Fork	5	at mouth	2	2	05 Jun 2000	NF Kentucky	
JRS-00-104	69	Laurel Fork	4	at upper Laurel Fork Road Bridge	3	2	05 Jun 2000	NF Kentucky	
JRS-00-105	70	Long Fork	1	at mouth	3	2	05 Jun 2000	NF Kentucky	
JRS-00-106	71	Clemons Fork	10	0.3 road miles upstream of confluence with Buckhorn Creek in Robinson Forest (reference)	3	0	06 Jun 2000	NF Kentucky	
JRS-00-107	72	Coles Fork	11	in Robinson Forest (reference)	3	0	06 Jun 2000	NF Kentucky	
JRS-00-108	73	Spring Fork	7	of Quicksand Creek just upstream of Hughes Creek	4	2	06 Jun 2000	NF Kentucky	

Table 2. PSU collection number, PSU station number, stream name, corresponding USEPA MT number where applicable, locality, stream order, EIS Class (0=unmined, 1=mined, 2=filled, 3=filled/residential, 4=mined/residential), sample date, drainage, and USEPA MT Basin for fish collections completed during Fall 2001in the primary region of MTM/VF coal mining in the Guyandotte River Drainage of West Virginia.

Collection #	PSU Station number	Stream Name	EPA MT	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-01-84	7	Sugartree Branch	MT-18	downstream of grouted spill way	2	2	9/14/2001	Guyandotte	Mud River
JRS-01-87	12	Ballard Fork	MT-14	approximately 100m above mouth	2	2	9/14/2001	Guyandotte	Mud River
JRS-01-85	17	Stanley Fork		upstream of valley fill and upstream of (MT-15)	3	2	9/14/2001	Guyandotte	Mud River
JRS-01-86	18	Stanley Fork	MT-15	downstream of valley fill, above beaver ponds	3	2	9/14/2001	Guyandotte	Mud River
JRS-01-88	19	Mud River	MT-07	upstream of Ballard fork upstream of bridge	3	3	9/14/2001	Guyandotte	Mud River
JRS-01-89	20	Mud River	MT-05	just upstream of Passenger Fork, downstream of Lukey Fork	3	3	9/14/2001	Guyandotte	Mud River
JRS-01-82	22	Mud River	MT-23	approximately 1800 ft downstream of confluence with Connelly Branch	4	3	9/14/2001	Guyandotte	Mud River
JRS-01-83	23	Mud River	MT-17	just upstream of Sugartree Branch	4	3	9/14/2001	Guyandotte	Mud River
JRS-01-90	74	Big Ugly		at mouth of Pigeon Roost - (Ref 1)	4	0	9/15/2001	Guyandotte	

Collection #	PSU Station number	Stream Name	EPA MT	Locality	Stream order	EIS Class	Sample Date	Drainage	MT Basin
JRS-01-91	75	Big Ugly		approximately downstream of mouth of Laurel Creek (Ref 2)	4	0	9/15/2001	Guyandotte	
JRS-01-92	76	Back Fork		0.3 mile above confluence with Laurel Creek (Ref 3)	2	0	9/15/2001	Guyandotte	
JRS-01-93	77	Laurel Creek		at confluence of Charley Fork (Ref 4)	2	0	9/15/2001	Guyandotte	
JRS-01-94	78	Laurel Creek		0.9 road miles upstream of confluence w/ Big Ugly Creek (Ref 5)	3	0	9/15/2001	Guyandotte	
JRS-01-95	79	Buffalo Run		approximately 0.25 miles upstream of entrance to Chief Logan State Park (Ref 6)	2	?	9/16/2001	Guyandotte	
JRS-01-96	80	Right Fork		of Buffalo Creek approximately 300 meter upstream of mouth (Ref 7)	1	?	9/16/2001	Guyandotte	
JRS-01-97	81	Buffalo Creek		above confluence with Right Fork of Buffalo Creek (Ref 8)	2	?	9/16/2001	Guyandotte	

Table 3A. Counts and measurements taken on each *Cottus* specimen.

Expressed as Percent Standard Length	Expressed as Percent Head Length	Counts
Head length	Horizontal eye diameter	No. of lateral-line pores
Snout to dorsal-fin origin	Vertical eye diameter	Branchialsteigal rays
Snout to pelvic-fin origin	Snout length	No. chin pores
Greatest body depth	Postorbital head length	No. center chin pores
1st dorsal-fin base length	Interorbital distance	1st dorsal-fin rays
2nd dorsal-fin base length		2nd dorsal-fin rays
Ant. 1st dorsal - ant anal		Pectoral-fin rays
Ant 2nd dorsal - ant. anal		Anal-fin rays
Post. 2nd dorsal - post anal		
Post. 1st dorsal - post. anal		
Post. 2nd dorsal - post. anal		
Post. 2nd dorsal - vent. caudal		
Post. anal - dorsal caudal		
Post. dorsal - pelvic-fin org.		
Anal-fin base length		

Table 3B. Counts and measurements taken on each *Nocomis* specimen.

Expressed as Percent Standard Length	Expressed as Percent Head Length	Counts
Head length	Horizontal eye diameter	Lateral-line scales
Snout to dorsal-fin origin	Vertical eye diameter	Scales above lateral line
Snout to pelvic-fin origin	Snout length	Scales below lateral line
Caudal peduncle depth	Postorbital head length	Dorsal rays
Greatest body depth	Lower jaw length	Anal rays
Body width	Upper jaw length	
	Head depth	
	Gape width	

Table 4. List of species collected in the primary region of mountain top removal / valley fill coal mining in West Virginia and Kentucky during Fall 1999/Spring 2000 and Fall 2001.

Scientific name	Common name
Lampetra aepyptera	Least brook lamprey
Oncorhynchus mykiss	Rainbow trout
Salmo trutta	Brown trout
Campostoma anomalum	Central stoneroller
Clinostomus funduloides	Rosyside dace
Cyprinella galactura	Whitetail shiner
Cyprinella spiloptera	Spotfin shiner
Cyprinus carpio	Common carp
Ericymba buccata	Silverjaw minnow
Luxilus albeolus	White shiner
Luxilus chrysocephalus	Striped shiner
Lythrurus ardens	Rosefin shiner
Nocomis micropogon	River chub
Nocomis platyrhynchus	Bigmouth chub
Notropis ludibundus	Sand shiner
Notropis photogenis	Silver shiner
Notropis rubellus	Rosyface shiner
Notropis telescopus	Telescope shiner
Notropis volucellus	Mimic shiner
Phoxinus erythrogaster	Southern redbelly dace
Pimephales notatus	Bluntnose minnow
Pimephales promelas	Fathead minnow
Rhinichthys atratulus	Blacknose dace
Semotilus atromaculatus	Creek chub
Catostomus commersoni	White sucker
Hypentelium nigricans	Northern hog sucker
Moxostoma erythrurum	Golden redhorse
Ameiurus melas	Black bullhead
Ameiurus natalis	Yellow bullhead
Ameiurus nebulosus	Brown bullhead
Noturus miurus	Brindled madtom
Labidesthes sicculus	Brook silverside
Cottus bairdi	Mottled sculpin
Ambloplites rupestris	Rock bass
Lepomis auritus	Redbreast sunfish
Lepomis cyanellus	Green sunfish
Lepomis cyanellusx L. macrochirus	Sunfish hybrid
Lepomis cyanellus x L. gibbosus	Sunfish hybrid
Lepomis gibbosus	Pumpkinseed
Lepomis macrochirus	Bluegill
Lepomis megalotis	Longear sunfish
Micropterus dolomieu	Smallmouth bass
Micropterus punctulatus	Spotted bass
Micropterus salmoides	Largemouth bass

Scientific name	Common name
Etheostoma baileyi	Emerald darter
Etheostoma blennioides	Greenside darter
Etheostoma caeruleum	Rainbow darter
Etheostoma flabellare	Fantail darter
Etheostoma kennicotti	Stripetail darter
Etheostoma nigrum	Johnny darter
Etheostoma sagitta	Arrow darter
Etheostoma variatum	Variegate darter
Etheostoma zonale	Banded darter
Percina caprodes	Logperch
Percina maculata	Blackside darter
Percina stictogaster	Frecklebelly darter

Table 5. Summary (total number of species, total number of individuals (indivs), total biomass caught, biomass caught per sq. meter sampled, number of individuals (indivs) per sq. meter sampled) of fish collections completed in Fall 1999 and Spring 2000 by PSU station, PSU collection number, and corresponding USEPA MT or Station number where applicable.

PSU Station	Collection #	EPA MT or Station	EIS Class	Stream Order	Area Sampled (m^2)	Total # Species	Total # Indivs	Total Biomass (g)	Biomass (g/m^2)	Indivs per m^2	Drainage
1	JRS-99-67	MT-57B	2	1	136.80	0	0	0.0	0.0	0.0	Guyandotte
2	JRS-99-69		0	1	136.67	0	0	0.0	0.0	0.0	Guyandotte
3	JRS-00-61	MT-58	2	1	273.33	1	12	31.7	0.1	0.0	Guyandotte
4	JRS-00-62	MT-52	2	1	167.20	1	14	45.5	0.3	0.1	Guyandotte
5	JRS-00-67	MT-13	0	1	60.20	2	13	95.8	1.6	0.2	Guyandotte
6	JRS-99-68	MT-60	2	2	322.00	2	59	535.1	1.7	0.2	Guyandotte
6	JRS-00-50[a]	MT-60	2	2	250.00	2[a]	25[a]	87.1[a]	0.35[a]	0.1[a]	Guyandotte
7	JRS-00-52	MT-18	2	2	217.60	2	9	50.9	0.2	0.0	Guyandotte
8	JRS-00-59	MT-50	0	2	196.80	2	44	73.3	0.4	0.2	Guyandotte
9	JRS-00-60	MT-59	2	2	366.00	1	12	77.3	0.2	0.0	Guyandotte
10	JRS-00-64	MT-02	0	2	218.13	1	3	1.5	0.0	0.0	Guyandotte
11	JRS-00-65	MT-03	0	2	287.00	9	27	171.7	0.6	0.1	Guyandotte
12	JRS-00-68	MT-14	2	2	166.88	12	157	1689.4	10.1	0.9	Guyandotte
13	JRS-00-69	MT-51	0	2	278.25	2	6	44.9	0.2	0.0	Guyandotte
14	JRS-00-91		3	3	1394.50	13	2336	14772.2	10.6	1.7	Guyandotte
15	JRS-99-70	MT-55	3	3	380.00	7	380	2224.3	5.9	1.0	Guyandotte
16	JRS-00-53	MT-01	4	3	383.47	15	438	9944.8	25.9	1.1	Guyandotte

PSU Station	Collection #	EPA MT or Station	EIS Class	Stream Order	Area Sampled (m^2)	Total # Species	Total # Indivs	Total Biomass (g)	Biomass (g/m^2)	Indivs per m^2	Drainage
17	JRS-00-54		2	3	216.00	7	82	424.1	2.0	0.4	Guyandotte
18	JRS-00-55	MT-15	2	3	172.50	6	38	318.2	1.8	0.2	Guyandotte
19	JRS-00-57	MT-07	3	3	538.33	13	291	1019.8	1.9	0.5	Guyandotte
20	JRS-00-58	MT-05	3	3	584.00	20	358	20418.8	35.0	0.6	Guyandotte
21	JRS-00-66	MT-04	4	3	408.63	14	115	1151.5	2.8	0.3	Guyandotte
22	JRS-99-76	MT-23	3	4	573.20	20	511	1650.7	2.9	0 9	Guyandotte
22	JRS-00-51[b]	MT-23	3	4	667.50	20	313	1474.0	2.2	0.5	Guyandotte
23	JRS-00-56	MT-17	3	4	523.75	19	199	2054.6	3.9	0.4	Guyandotte
24	JRS-00-92	MT-42	0	1	40.00	0	0	0.0	0.0	0.0	Kanawha
25	JRS-99-71	MT-25B	2	2	330.33	3	67	497.3	1.5	0.2	Kanawha
26	JRS-99-80	MT-64	2	2	107.33	3	137	371.7	3.5	1.3	Kanawha
27	JRS-99-81	MT-69	4	2	133.79	2	139	248.0	1.9	1.0	Kanawha
28	JRS-00-73	MT-70	3	2	151.43	3	109	372.5	2.5	0.7	Kanawha
29	JRS-00-76	MT-79	1	2	68.80	2	17	114.9	1.7	0.2	Kanawha
30	JRS-00-79	MT-80	1	2	87.00	2	5	5.4	0.1	0.1	Kanawha
31	JRS-00-80		1	2	40.00	0	0	0.0	0.0	0.0	Kanawha
32	JRS-00-93	MT-39	0	2	102.40	1	20	20.6	0.2	0.2	Kanawha
33	JRS-99-72	MT-32	2	3	220.53	14	167	1225.3	5.6	0.8	Kanawha
34	JRS-99-73	MT-45	1	3	111.60	2	43	53.0	0.5	0.4	Kanawha

PSU Station	Collection #	EPA MT or Station	EIS Class	Stream Order	Area Sampled (m^2)	Total # Species	Total # Indivs	Total Biomass (g)	Biomass (g/m^2)	Indivs per m^2	Drainage
35	JRS-99-78		1	3	283.67	6	207	658.4	2.3	0.7	Kanawha
36	JRS-99-79	MT-62	3	3	212.00	7	420	1893.1	8.9	2.0	Kanawha
37	JRS-99-82	MT-70	3	3	50.00	0	0	0.0	0.0	0.0	Kanawha
38	JRS-00-70	MT-28	2	3	406.02	9	90	1110.2	2.7	0.2	Kanawha
39	JRS-00-74	MT-63	3	3	222.13	4	274	2269.5	10.2	1.2	Kanawha
40	JRS-00-77	MT-85	1	3	418.67	2	51	577.6	1.4	0.1	Kanawha
41	JRS-00-78	MT-81	1	3	251.67	2	26	370.6	1.5	0.1	Kanawha
42	JRS-99-74	MT-40	3	4	1372.50	14	498	1406.0	1.0	0.4	Kanawha
43	JRS-00-71	MT-46	3	4	1220.00	13	527	5693.1	4.7	0.4	Kanawha
44	JRS-00-72	MT-47	3	4	1778.00	18	488	7719.6	4.3	0.3	Kanawha
45	JRS-99-75		3	5	1590.00	20	507	4372.7	2.8	0.3	Kanawha
46	JRS-00-88	MT-93	0	1	30.00	0	0	0.0	0.0	0.0	New
47	JRS-99-86	MT-98	2	2	305.00	3	43	203.9	0.7	0.1	New
48	JRS-00-83		1	3	472.00	8	277	883.2	1.9	0.6	New
49	JRS-00-84	MT-87	2	2	234.93	3	89	165.5	0.7	0.4	New
50	JRS-00-85	MT-95	0	2	65.60	5	52	53.9	0.8	0.8	New
51	JRS-00-86		0	2	97.30	6	65	278.8	2.9	0.7	New
52	JRS-00-87	MT-91	0	2	297.87	6	183	564.3	1.9	0.6	New
53	JRS-00-89	MT-94	0	2	88.00	3	13	34.2	0.4	0.1	New

PSU Station	Collection #	EPA MT or Station	EIS Class	Stream Order	Area Sampled (m^2)	Total # Species	Total # Indivs	Total Biomass (g)	Biomass (g/m^2)	Indivs per m^2	Drainage
54	JRS-99-84		2	3	1286.00	17	279	3589.0	2.8	0.2	New
55	JRS-99-85		2	3	301.00	9	327	1041.0	3.5	1.1	New
56	JRS-00-81	MT-86	2	3	296.80	6	149	754.9	2.5	0.5	New
57	JRS-00-82		2	4	1036.50	9	238	2375.1	2.3	0.2	New
58	JRS-99-83		2	4	800.00	16	248	2564.8	3.2	0.3	New
59	JRS-00-95	8	2	4	1350.00	14	430	6061.4	4.5	0.3	Cumberland
60	JRS-00-96	6	2	3	377.67	7	881	2976.0	7.9	2.3	Cumberland
61	JRS-00-97		0	3	1027.48	16	494	7369.3	7.2	0.5	Cumberland
62	JRS-00-94	12	0	2	423.67	20	784	2354.0	5.6	1.9	Kentucky
63	JRS-00-98	13	0	2	231.20	12	559	691.1	3.0	2.4	Kentucky
64	JRS-00-99	3	2	2	173.87	10	91	444.5	2.6	0.5	NF Kentucky
65	JRS-00-100	2	2	2	298.13	6	514	1113.9	3.7	1.7	NF Kentucky
66	JRS-00-101	9	3	3	827.00	13	281	799.8	1.0	0.3	NF Kentucky
67	JRS-00-102	14	2	3	282.13	4	94	349.8	1.2	0.3	NF Kentucky
68	JRS-00-103	5	2	2	102.83	12	112	233.1	2.3	1.1	NF Kentucky
69	JRS-00-104	4	2	3	317.33	14	121	607.0	1.9	0.4	NF Kentucky
70	JRS-00-105	1	2	3	140.40	2	23	192.0	1.4	0.2	NF Kentucky
71	JRS-00-106	10	0	3	211.06	12	654	1205.7	5.7	3.1	NF Kentucky
72	JRS-00-107	11	0	3	117.47	9	220	401.2	3.4	1.9	NF Kentucky

PSU Station	Collection #	EPA MT or Station	EIS Class	Stream Order	Area Sampled (m^2)	Total # Species	Total # Indivs	Total Biomass (g)	Biomass (g/m^2)	Indivs per m^2	Drainage
73	JRS-00-108	7	2	4	426.67	7	76	114.1	0.3	0.2	NF Kentucky

[a]Two collections were completed at Station 6 (JRS-99-68 in Fall 1999 and JRS-00-50 in Spring 2000). The Spring collection, JRS-00-50 consisted of a single pass of electrofishing because of the small size of the stream and the simple fish assemblage (2 species). As such, numbers of individuals caught and biomass caught are most likely underestimated for the Spring sample.

[b]Two collections were completed at Station 22 (JRS-99-76 in Fall 1999 and JRS-00-51 in Spring 2000). Three passes of electrofishing were completed in each case.

Table 6. Total number of individuals of each species collected in the Guyandotte River Drainage by PSU station number (PSU collection number and EPA MT or Station number are available in Table 5). Stream order and EIS class are also included for each station. Two stations (6 and 22) were sampled both during Fall 1999 and Spring 2000 – seasonal collections are designated by F (fall collection) and S (spring collection).

Guyandotte River Fishes

Stream order	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4
EIS Class	*2*	*0*	*2*	*2*	*0*	*2*	*2*	*2*	*0*	*2*	*0*	*0*	*2*	*0*	*3*	*3*	*4*	*2*	*2*	*3*	*3*	*4*	*3*	*3*	*3*
STATION	**1**	**2**	**3**	**4**	**5**	**6F**	**6S**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22F**	**22S**	**23**
Lampetra aepyptera																	10			1	2	1			
Campostoma anomalum												3	11		198	10	64	24	7	36	74	34	145	66	
Clinostomus funduloides												2					41	1							
Ericymba buccata	N	N											2		171	7	17				26	1	5	28	6
Luxilus chrysocephalus													4		1		21			11	45	18	3	27	7
Notropis ludibundus	O	O													360								21	62	12
Notropis photogenis																							1		
Notropis rubellus																							4	3	
Pimephales notatus	F	F											2		352		15			13	16	2		5	23
Pimephales promelas																			2						
Rhinichthys atratulus	I	I	12	14	1	41	22	2	15	12	3	1	1	1	629	231	77	1	1			1			3
Semotilus atromaculatus					12	18	3	7	29			11	45	5	185	73	122	13	11	16	26	29	36	9	9
Catostomus commersoni	S	S										1	8		58	15	28		1	1	57	3	5	4	
Hypentelium nigricans												2			46	35				7	1	4	9	20	8
Moxostoma erythrurum	H	H															2				12			1	2
Ameirus natalis																							1	1	1
Noturus miurus																							1		
Ambloplites rupestris													1								2			1	2
Lepomis cyanellus												3	53		1		8	31	16	30	24	12	60	16	83
Lepomis macrochirus																					1	1	3	1	3
Lepomis megalotis																	1				1		1		4
Micropterus punctulatus																					1		1		
Micropterus salmoides															2								1		2
Etheostoma blennioides															43			6		3	2		37	20	14
Etheostoma caeruleum												2	24		290	9	8	6		82	9	4	114	28	8

Stream order	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4
EIS Class	*2*	*0*	*2*	*2*	*0*	*2*	*2*	*2*	*0*	*2*	*0*	*0*	*2*	*0*	*3*	*3*	*4*	*2*	*2*	*3*	*3*	*4*	*3*	*3*	*3*
STATION	**1**	**2**	**3**	**4**	**5**	**6F**	**6S**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22F**	**22S**	**23**
Etheostoma flabellare													2				15			24	15	2			
Etheostoma nigrum												2	4				9			65	36	3	5	1	6
Etheostoma zonale																				2	6		58	16	4
Percina caprodes																					2			3	2
Percina maculata																								1	
TOTAL INDIVIDUALS	0	0	12	14	13	59	25	9	44	12	3	27	157	6	2336	380	438	82	38	291	358	115	511	313	199
TOTAL SPECIES	**0**	**0**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**9**	**12**	**2**	**13**	**7**	**15**	**7**	**6**	**13**	**20**	**14**	**20**	**20**	**19**

Table 7. Total number of individuals of each species collected in the Kanawha River Drainage by PSU station number (PSU collection number and EPA MT or Station number are available in Table 5). Stream order and EIS class are also included for each station.

Kanawha River Fishes

Stream order	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	5
EIS Class	*0*	*2*	*2*	*4*	*3*	*1*	*1*	*1*	*0*	*2*	*1*	*1*	*3*	*3*	*2*	*3*	*1*	*1*	*3*	*3*	*3*	*3*
STATION	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Lampetra aepyptera																					1	
*Salmo trutta**													3									
Campostoma anomalum	N							N		61		6	5	N	18				28		86	14
Cyprinella spiloptera																						1
Cyprinus carpio	O							O						O					1			
Ericymba buccata																					19	
Luxilus chrysocephalus										2					1				3	30	47	19
Notropis ludibundus	F							F						F					45			46
Notropis photogenis																			2	23	10	8
Notropis rubellus	I							I		1				S					43	94	86	66
Notropis volucellus																				1	12	
Phoxinus erythrogaster	S		1					S						I								
Pimephales notatus										2												4
Rhinichthys atratulus	H	7	107	9	14	11	4	H	20	1	37	111	44	H	9	62	18	6	27	4	12	1
Semotilus atromaculatus		59	29		7	6	1			12	6	41	35		13	2	33	20	35	13	23	1
Catostomus commersoni										3			1		19							
Hypentelium nigricans										4		5	7		6	10			24	27	20	40
Moxostoma erythrurum																					4	
Cottus bairdi				130	88					1		12	327		3	200			187	149	79	6
Ambloplites rupestris																				2	2	8
Lepomis cyanellus		1								24					5							1
Lepomis macrochirus										32					16						1	2
Micropterus dolomieu																			2	13	9	12
Micropterus salmoides										1												
Etheostoma blennioides																			1	7	2	14
Etheostoma caeruleum										18			1						87	160	74	218

Stream order	1	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	5
EIS Class	*0*	*2*	*2*	*4*	*3*	*1*	*1*	*1*	*0*	*2*	*1*	*1*	*3*	*3*	*2*	*3*	*1*	*1*	*3*	*3*	*3*	*3*
STATION	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Etheostoma flabellare												32										
Etheostoma nigrum										5												15
Etheostoma variatum																						9
Etheostoma zonale																			13	4	1	22
TOTAL INDIVIDUALS	0	67	137	139	109	17	5	0	20	167	43	207	420	0	90	274	51	26	498	527	488	507
TOTAL SPECIES	**0**	**3**	**3**	**2**	**3**	**2**	**2**	**0**	**1**	**14**	**2**	**6**	**7**	**0**	**9**	**4**	**2**	**2**	**14**	**13**	**18**	**20**

**Salmo trutta* were caught outside of the sample reach (therefore are not included in column totals) and were measured and released.

Table 8. Total number of individuals of each species collected in the New River Drainage by PSU station number (PSU collection number and EPA MT or Station number are available in Table 5). Stream order and EIS class are also included for each station.

New River Fishes

Stream order	1	2	3	2	2	2	2	2	3	3	3	4	4
EIS Class	*0*	*2*	*1*	*2*	*0*	*0*	*0*	*0*	*2*	*2*	*2*	*2*	*2*
STATION	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**
Campostoma anomalum			13		7	25	1		27	72		17	63
Cyprinella galactura									18				
Ericymba buccata	N												7
Luxilus albeolus									8			12	30
Luxilus chrysocephalus	O					5			1				
Nocomis platyrhynchus									46	72			15
Notropis rubellus									16				
Notropis telescopus	F								75				3
Notropis volucellus									1				
Pimephales notatus	I								3				1
Rhinichthys atratulus		40	112	72			89	7		46	70	69	
Semotilus atromaculatus	S	2	50	12	4	5	31	3		21	40	53	26
Catostomus commersoni		1	8				4				11	15	4
Hypentelium nigricans	H		1						13	1		10	20
Cottus bairdi			22		1		30	3			3	21	2
Ambloplites rupestris									15				17
Lepomis cyanellus									6	11			11
Lepomis cyanellus x L. macrochirus										1			
Micropterus dolomieu									3				7
Etheostoma blennioides									2				
Etheostoma caeruleum			2		38	17			36	95	1	18	31
Etheostoma flabellare			69	5	2	12	28		5	8	24	23	2
Etheostoma nigrum						1			4				9
TOTAL INDIVIDUALS	0	43	277	89	52	65	183	13	279	327	149	238	248
TOTAL SPECIES	**0**	**3**	**8**	**3**	**5**	**6**	**6**	**3**	**17**	**9**	**6**	**9**	**16**

Table 9. Total number of individuals of each species collected in the Cumberland and Kentucky River Drainages by PSU station number (PSU collection number and EPA MT or Station number are available in Table 5). Stream order and EIS class are also included.

Cumberland & Kentucky River Fishes

Stream order	4	3	3	2	2	2	2	3	3	2	3	3	3	3	4
EIS Class	*2*	*2*	*0*	*0*	*0*	*2*	*2*	*3*	*2*	*2*	*2*	*2*	*0*	*0*	*2*
STATION	**59**	**60**	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**
Lampetra aepyptera															2
Oncorhynchus mykiss				1											
Campostoma anomalum	94	154	8	100	41	5	1	32	1	7	15		93	113	3
Ericymba buccata					2								44		
Luxilus chrysocephalus	25		4	125	6	1		15		76	39		47	12	
Lythrurus ardens			5	35											
Nocomis micropogon										1					
Notropis ludibundus								1							
Notropis rubellus	3		1					1			3				
Phoxinus erythrogaster			1		108										
Pimephales notatus	37	1	83	68	2	6		1		1	4				3
Rhinichthys atratulus		276				35	294		2		2				
Semotilus atromaculatus	1	306	24	44	95	30	93	80	90	9	28	22	101	54	42
Catostomus commersoni				1		4		2			1				19
Hypentelium nigricans	30	7	15	13		1	6	25		2		1	4		6
Moxostoma erythrurum				3		1									
Ameiurus natalis											2				
Noturus miurus										1					
Ambloplites rupestris	26		3	4						1					
Lepomis auritus	39		148												
Lepomis cyanellus						3					3				
Lepomis cyanellus x L. gibbosus								1							
Lepomis macrochirus			88				1		1		6				
Lepomis megalotis				1											
Micropterus dolomieu	6			1				1							
Micropterus punctulatus	11		2												
Etheostoma baileye	4		3	11	21			3		1	5		60	7	
Etheostoma blennioides			1	50	59			3		5	3		19	7	1
Etheostoma caeruleum	115	121	88	196	97		119	116		7	9		75	20	
Etheostoma flabellare	32	16		91	59	5							85	3	
Etheostoma kennicotti	7		20												
Etheostoma nigrum				23	64								124	2	
Etheostoma sagitta				1									1		
Etheostoma variatum										1	1				
Percina maculata				10									1	2	
Percina stictogaster				6	5										
TOTAL INDIVIDUALS	430	881	494	784	559	91	514	281	94	112	121	23	654	220	76
TOTAL SPECIES	**14**	**7**	**16**	**20**	**12**	**10**	**6**	**13**	**4**	**12**	**14**	**2**	**12**	**9**	**7**

Table 10. Summary (total number of species, total number of individuals (indivs), total biomass caught, biomass caught per sq. meter sampled, number of individuals (indivs) per sq. meter sampled) of fish collections completed in Fall 2001 in the Guyandotte River Drainage by PSU station, PSU collection number, and corresponding USEPA MT or Station number where applicable.

PSU Station	Collection #	EPA MT or Station	EIS Class	Stream Order	Area Sampled (m^2)	Total # Species	Total # Indivs	Total Biomass (g)	Biomass (g/m^2)	Indivs per m^2	Basin
7	JRS-01-84	MT-18	2	2	168.27	2	9	99	1.3	0.1	Mud River
12	JRS-01-87	MT-14	2	2	161.50	6	21	362	2.2	0.1	Mud River
17	JRS-01-85		2	3	280.00	9	32	547	2.0	0.1	Mud River
18	JRS-01-86	MT-15	2	3	130.00	6	20	338	2.6	0.2	Mud River
19	JRS-01-88	MT-07	3	3	503.33	8	107	331	0.7	0.2	Mud River
20	JRS-01-89	MT-05	3	3	356.00	18	251	1612	4.5	0.7	Mud River
22	JRS-01-82	MT-23	3	4	700.00	12	107	1290	1.8	0.2	Mud River
23	JRS-01-83	MT-17	3	4	487.50	8	29	1250	2.6	0.1	Mud River
74	JRS-01-90		0	4	906.66	24	504	2258	2.5	0.6	Big Ugly
75	JRS-01-91		0	4	766.66	21	818	2351	3.1	1.1	Big Ugly
76	JRS-01-92		0	2	115.00	12	171	450	3.9	1.5	Big Ugly
77	JRS-01-93		0	2	110.83	13	145	462	4.2	1.3	Big Ugly
78	JRS-01-94		0	3	340.66	17	525	1354	4.0	1.5	Big Ugly
79	JRS-01-95		?	2	347.66	7	668	3691	10.6	1.9	Buffalo Creek
80	JRS-01-96		?	1	77.00	2	144	355	4.6	1.9	Buffalo Creek
81	JRS-01-97		?	2	118.33	2	78	141	1.2	0.7	Buffalo Creek

Table 11. Total number of individuals of each species collected during Fall 2001 in the Guyandotte River Drainage by PSU station number (PSU collection number and EPA MT or Station number are available in Table 10). Stream order and EIS classification is also included.

Guyandotte River Fishes – Fall 2001

Stream Order	2	2	3	3	3	3	4	4	4	4	2	2	3	2	1	2
EIS Class	*2*	*2*	*2*	*2*	*3*	*3*	*3*	*3*	*0*	*0*	*0*	*0*	*0*	*?*	*?*	*?*
STATION	**7**	**12**	**17**	**18**	**19**	**20**	**22**	**23**	**74**	**75**	**76**	**77**	**78**	**79**	**80**	**81**
Lampetra aepyptera						2			30	4		1	4			
Campostoma anomalum		2	1	1		11	29	1	11	56	13	3	29	154		
Clinostomus funduloides						2						5				
Cyprinella spiloptera									11							
Ericymba buccata					1	8			29	16	23	17	50	21		
Luxilus chrysocephalus						1	1	1	81	207	9	2	47			
Notropis ludibundus							1		2	14						
Notropis rubellus									4	3						
Pimephales notatus		1			1	4			80	174	4	5	66	9		
Pimephales promelas			2	3												
Rhinichthys atratulus					6	3					29	18	2	141	92	38
Semotilus atromaculatus	3	13	11	2	50	115	12	4	46	54	50	57	74	314	52	40
Catostomus commersoni		2	2			13		2				2		25		
Hypentelium nigricans				1			2		9	24		1	7	4		
Moxostoma erythrurum									17							
Ameiurus melas			1													
Ameiurus natalis							1	2								
Ameiurus nebulosus				1												
Noturus miurus									4							
Labidesthes sicculus						16										
Ambloplites rupestris								1	1	2			7			
Lepomis cyanellus	6	2	12	12	22	38	16									
Lepomis gibbosus										3						
Lepomis macrochirus			1			1		1	4							
Lepomis megalotis						1		17	19	12	2		23			
Micropterus dolomieu									1	4	2		5			
Micropterus punctulatus						3	1		19	4						
Etheostoma blennioides			1				10		7	26			5			
Etheostoma caeruleum		1	1		10	4	22		22	77	30	24	144			
Etheostoma flabellare					12	16			11	15	5	5	14			
Etheostoma nigrum					5	10	2		84	89	2	5	36			
Etheostoma variatum									4	14			6			
Etheostoma zonale							10		5	16						
Percina caprodes						3										
Percina maculata									3	4	2		6			
TOTAL INDIVIDUALS	9	21	32	20	107	251	107	29	504	818	171	145	525	668	144	78
TOTAL SPECIES	**2**	**6**	**9**	**6**	**8**	**18**	**12**	**8**	**24**	**21**	**12**	**13**	**17**	**7**	**2**	**2**

Table 12. Water chemistry measurements for sites in the Mud River, Big Ugly, and Guyandotte drainages sampled in September 2001. Chemical analyses were conducted by REIC (data sheets available in Appendix D). In-situ pH and conductivity were measured on site using an Oakton pH Testr and an Oakton TDS Testr 20.

PSU Station	PSU Collection No.	EPA MT or Station No.	EIS Class	Stream Order	Total Al mg/L	Total Fe mg/L	Total As mg/L	Total Cu mg/L	Total Se mg/L	Hardness mg/L as CaCO3	In-situ pH	In-situ Conduct. µmhos/cm
7	JRS-01-84	MT-18	2	2	0.147	0.308	ND	ND	0.0315	1510.0	7.6	2290
12	JRS-01-87	MT-14	2	2	0.514	1.440	ND	ND	ND	1330.0	7.9	1953.00
17	JRS-01-85		2	3	0.437	0.854	ND	ND	0.0095	1520.0	8.2	2330
18	JRS-01-86	MT-15	2	3	10.400	43.600	ND	0.027	0.0158	1660.0	8.3	2160
19	JRS-01-88	MT-07	3	3	0.117	0.318	ND	ND	ND	267.0	8.0	530.00
20	JRS-01-89	MT-05	3	3	0.174	1.330	ND	ND	ND	245.0	7.3	513.00
22	JRS-01-82	MT-23	3	4	0.177	0.250	ND	ND	0.0121	1140.0	7.9	1836.00
23	JRS-01-83	MT-17	3	4	0.154	0.398	ND	ND	0.0107	1380.0	8.1	2120
74	JRS-01-90		0	4	0.077	1.060	ND	ND	ND	72.9	7.1	210.00
75	JRS-01-91		0	4	0.138	0.560	ND	ND	ND	76.7	7.0	206.00
76	JRS-01-92		0	2	0.092	0.125	ND	ND	ND	73.6	7.2	137.00
77	JRS-01-93		0	2	0.296	1.330	ND	ND	ND	60.4	7.0	143.00
78	JRS-01-94		0	3	0.064	0.500	ND	ND	ND	48.8	7.0	125.00
79	JRS-01-95		?	2	0.146	0.062	ND	ND	ND	407.0	6.4	883.00
80	JRS-01-96		?	1	0.089	0.088	ND	ND	ND	129.0	6.5	280.00
81	JRS-01-97		?	2	0.158	0.075	ND	ND	ND	441.0	6.3	926.00

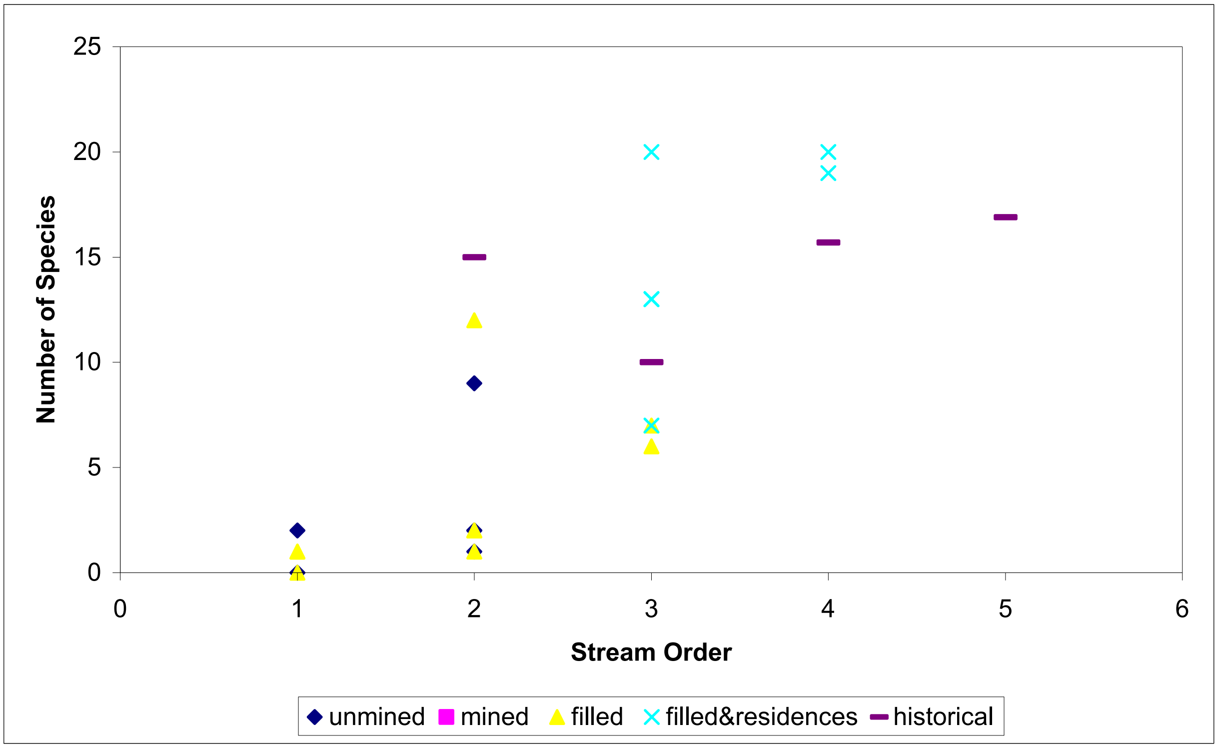

Figure 1. Comparison of number of species found in the Guyandotte River drainage (Mud River and Island Creek watersheds) in sites classified as unmined, mined, filled, filled/residential, and mined/residential and number of species recorded in historical collections in the Guyandotte River by stream order (Stauffer et al. 1989).

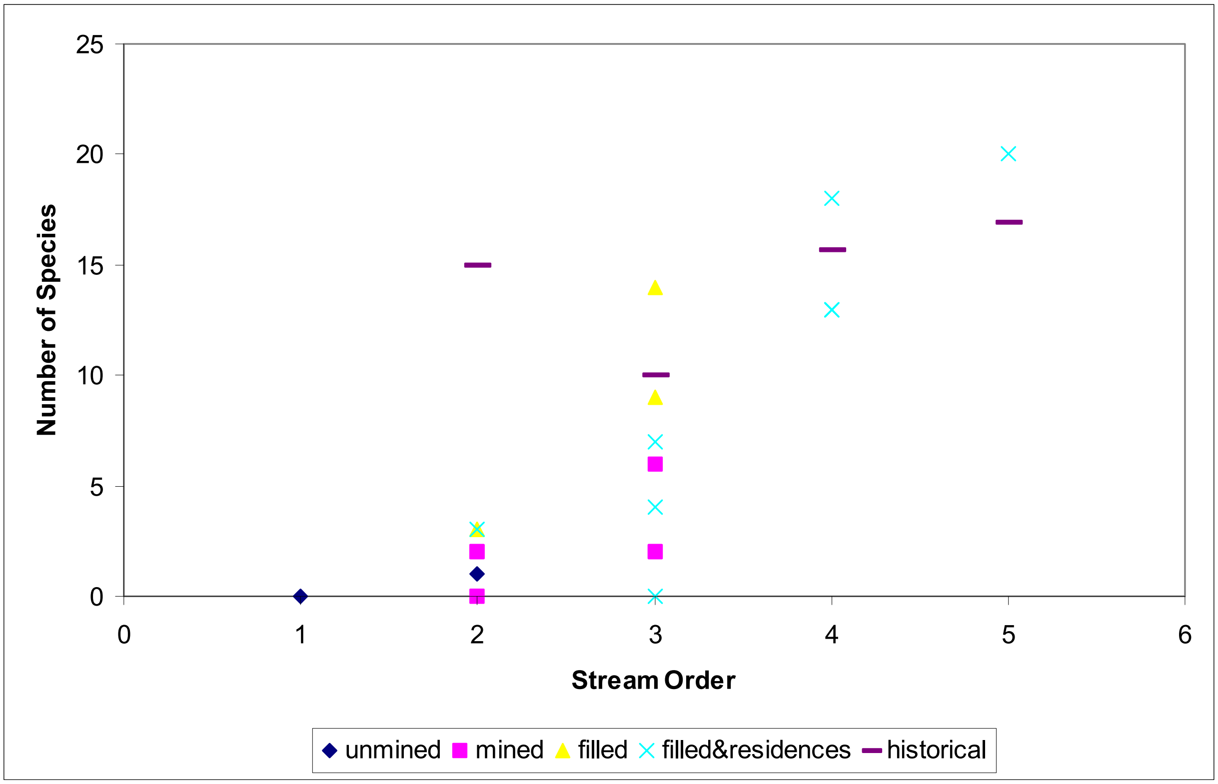

Figure 2. Comparison of number of species found in the Kanawha River drainage (Spruce Fork and Clear Fork watersheds) in sites classified as unmined, mined, filled, filled/residential, and mined/residential and number of species recorded in historical collections in the Guyandotte River by stream order (Stauffer et al. 1989). Because the Guyandotte River Drainage and the Kanawha River Drainage below Kanawha Falls are in the Ohio River system, fish communities are similar and historical collections from the Guyandotte River can serve as baseline for Kanawha River drainage collections.

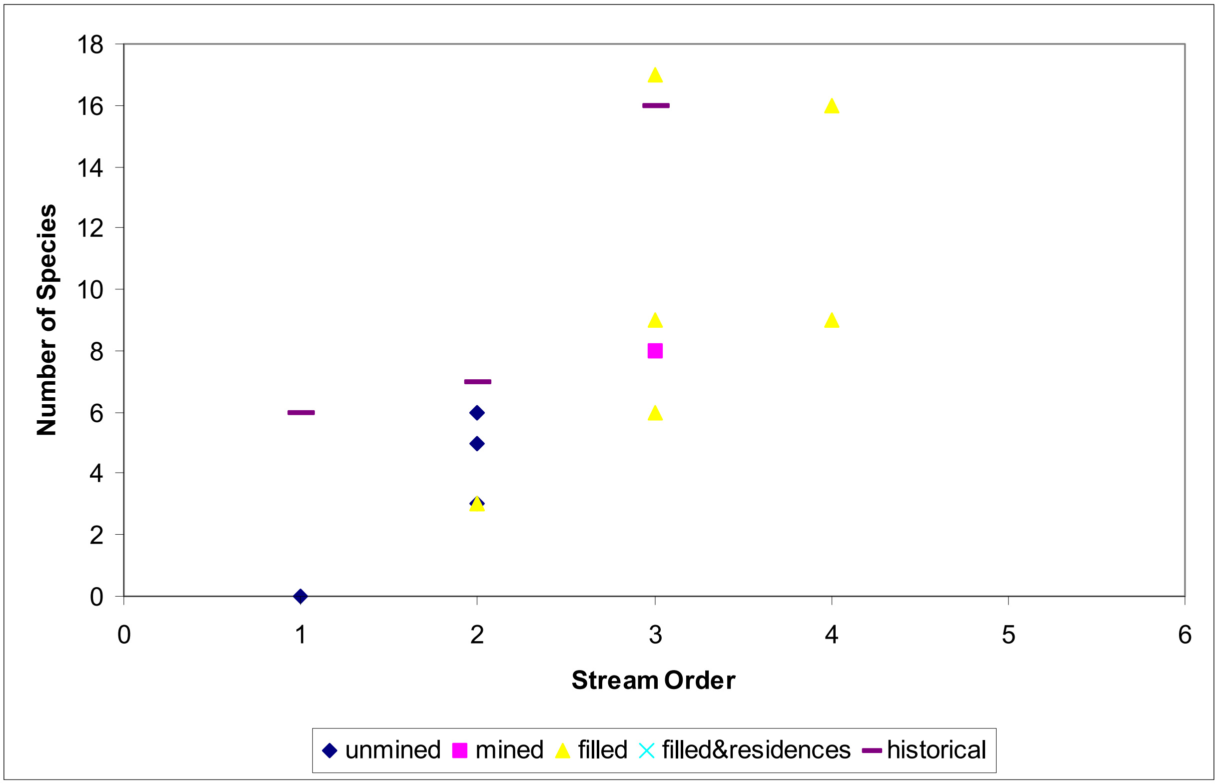

Figure 3. Comparison of number of species found in the New River drainage (Twentymile Creek watershed) in sites classified as unmined, mined, filled, filled/residential, and mined/residential and number of species recorded in historical collections in the Greenbrier River by stream order (Hocutt et al. 1978).

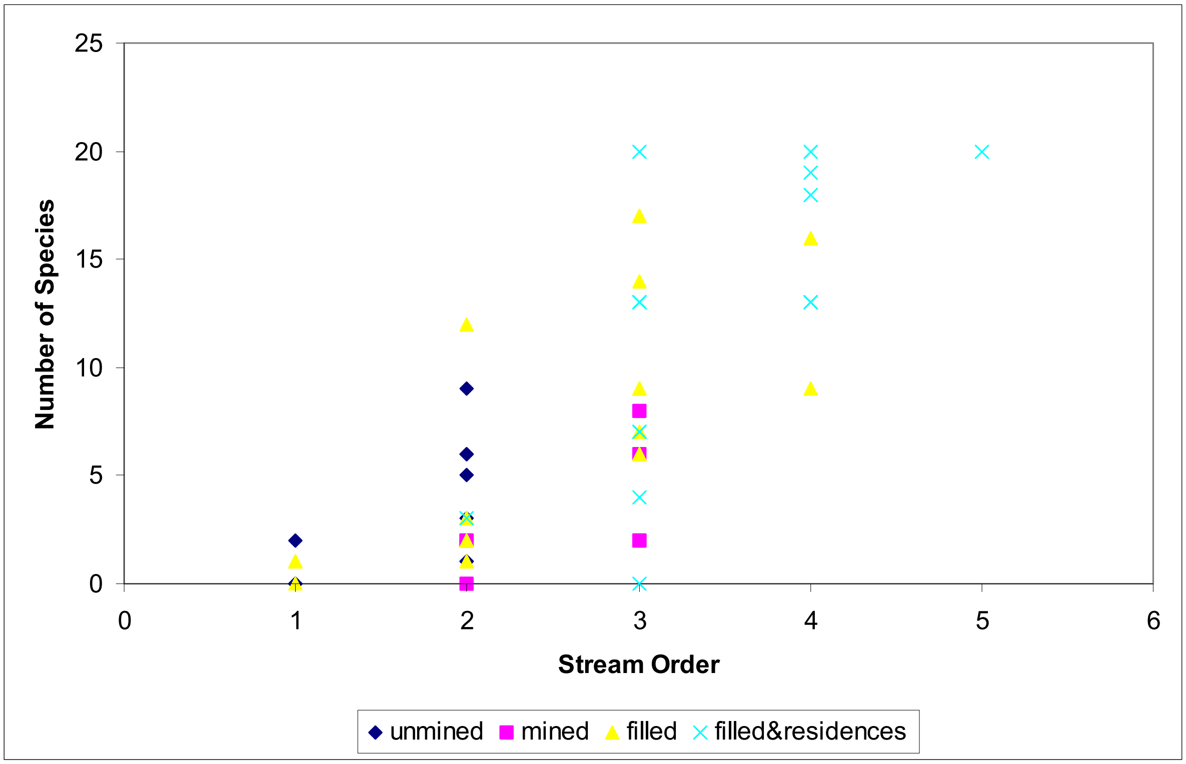

Figure 4. Relationship between total number of species collected and stream order sampled by EIS classification for 58 sites sampled in West Virginia. As stream order increases, the total number of species present increases ($R^2 = 0.5849$; $P < 0.001$). Unmined sites are located only on 1st and 2nd order streams while most of the mined, filled, filled/residential sites occur on 3rd, 4th, and 5th order streams.

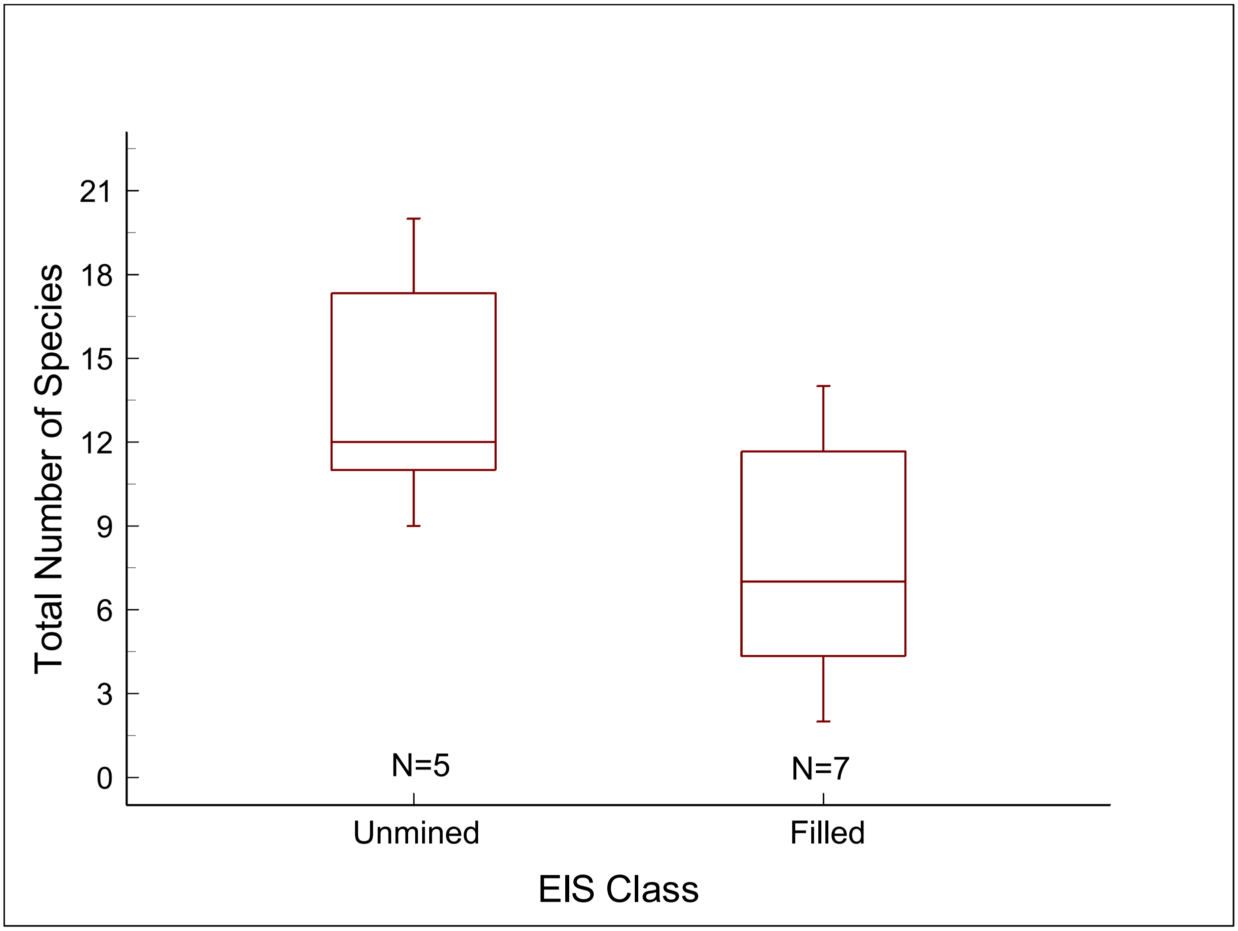

Figure 5. Comparison of number of total number of species between unmined (EIS Class = 0) and filled (EIS = 2) sites in 2nd and 3rd order streams in Kentucky. Sites were pooled across stream order for this analysis because we sampled both filled and unmined sites in both stream orders (two unmined sites and three filled sites in 2nd order streams, three unmined sites and four filled sites in 3rd order streams).

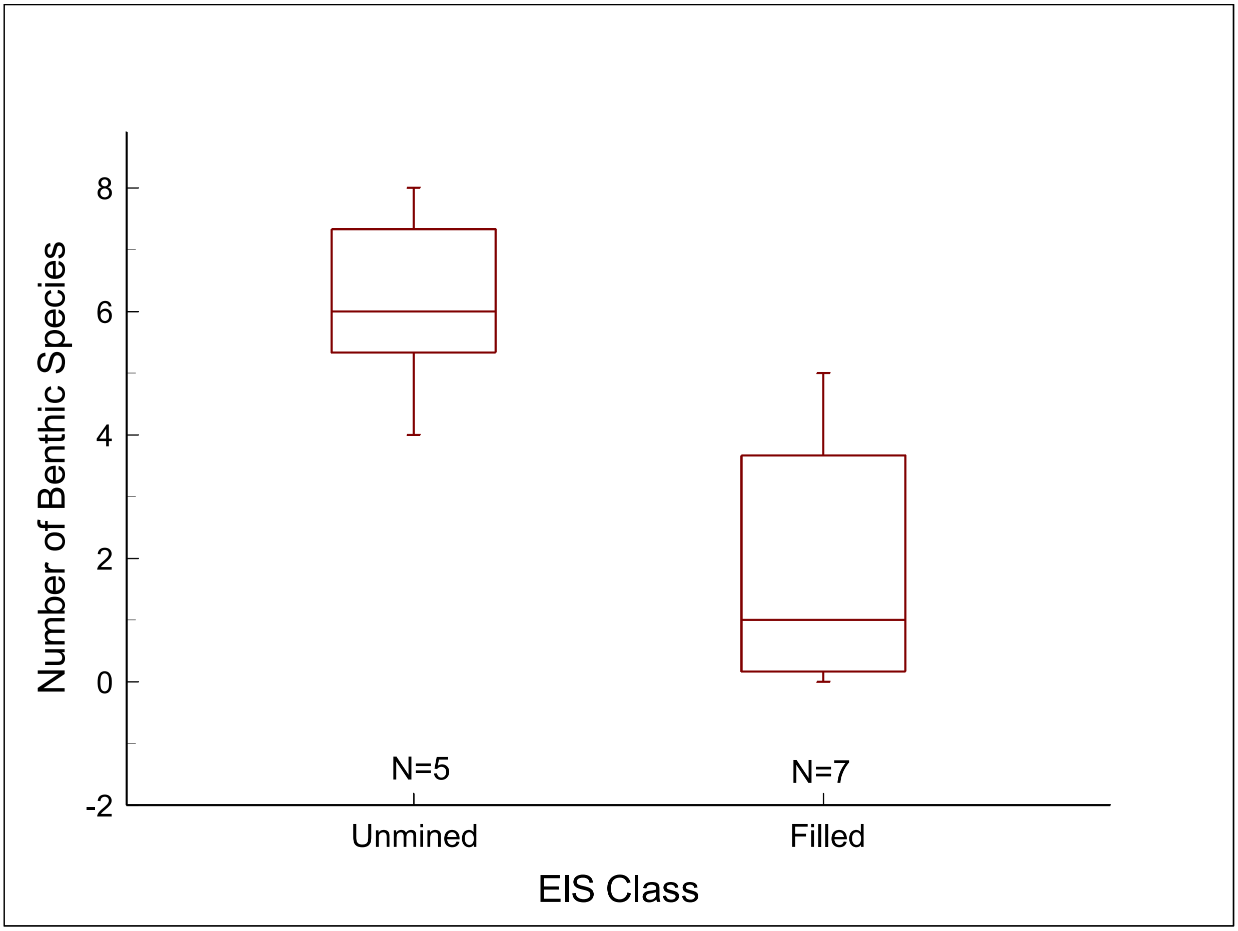

Figure 6. Comparison of number of benthic species between unmined (EIS Class = 0) and filled (EIS = 2) sites in sites in 2nd and 3rd order streams in Kentucky. Sites were pooled across stream order for this analysis because we sampled both filled and unmined sites in both stream orders (two unmined sites and three filled sites in 2nd order streams, three unmined sites and four filled sites in 3rd order streams).

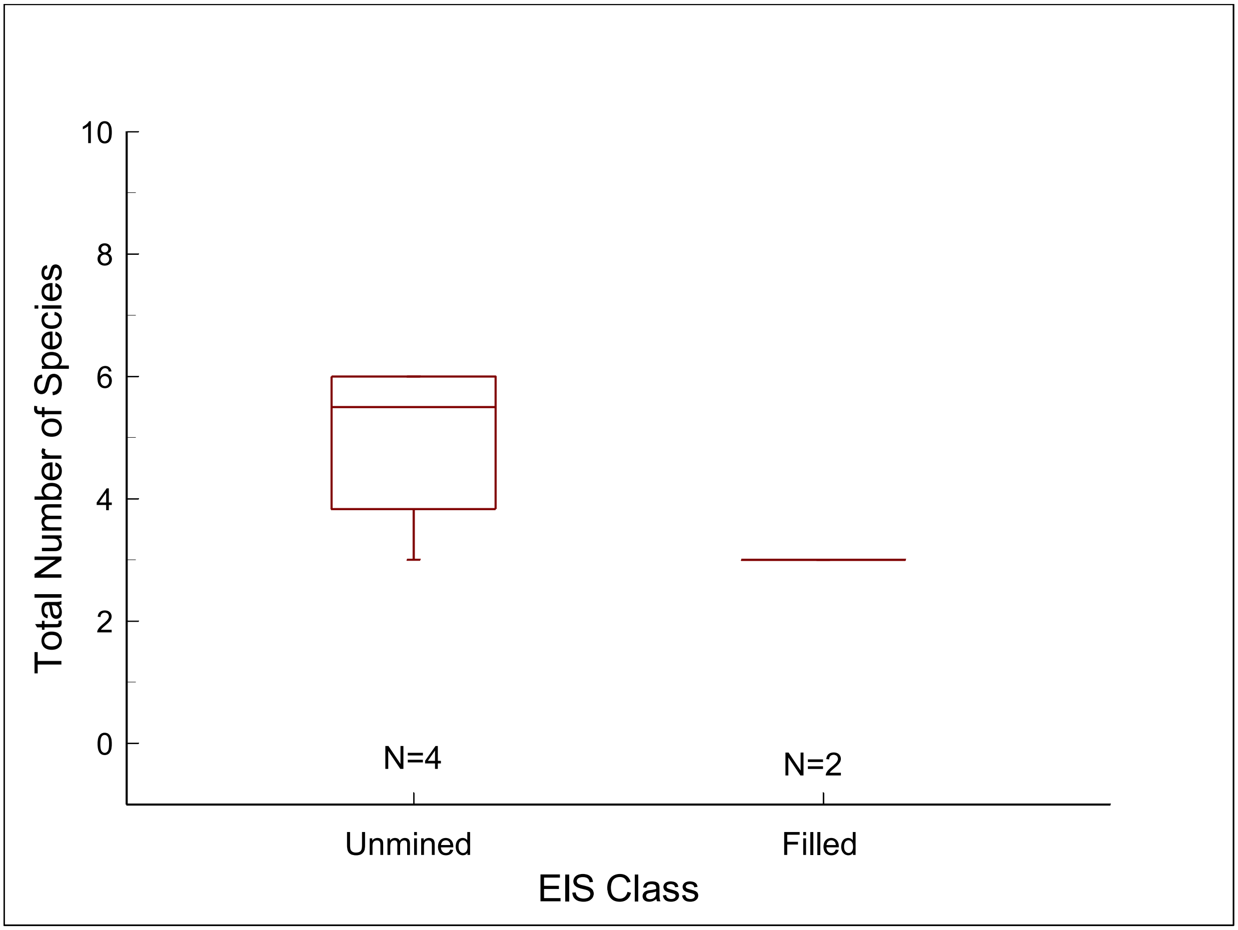

Figure 7. Comparison of total number species between unmined (EIS Class = 0) and filled (EIS = 2) sites in second order streams in Twentymile Creek watershed, West Virginia.

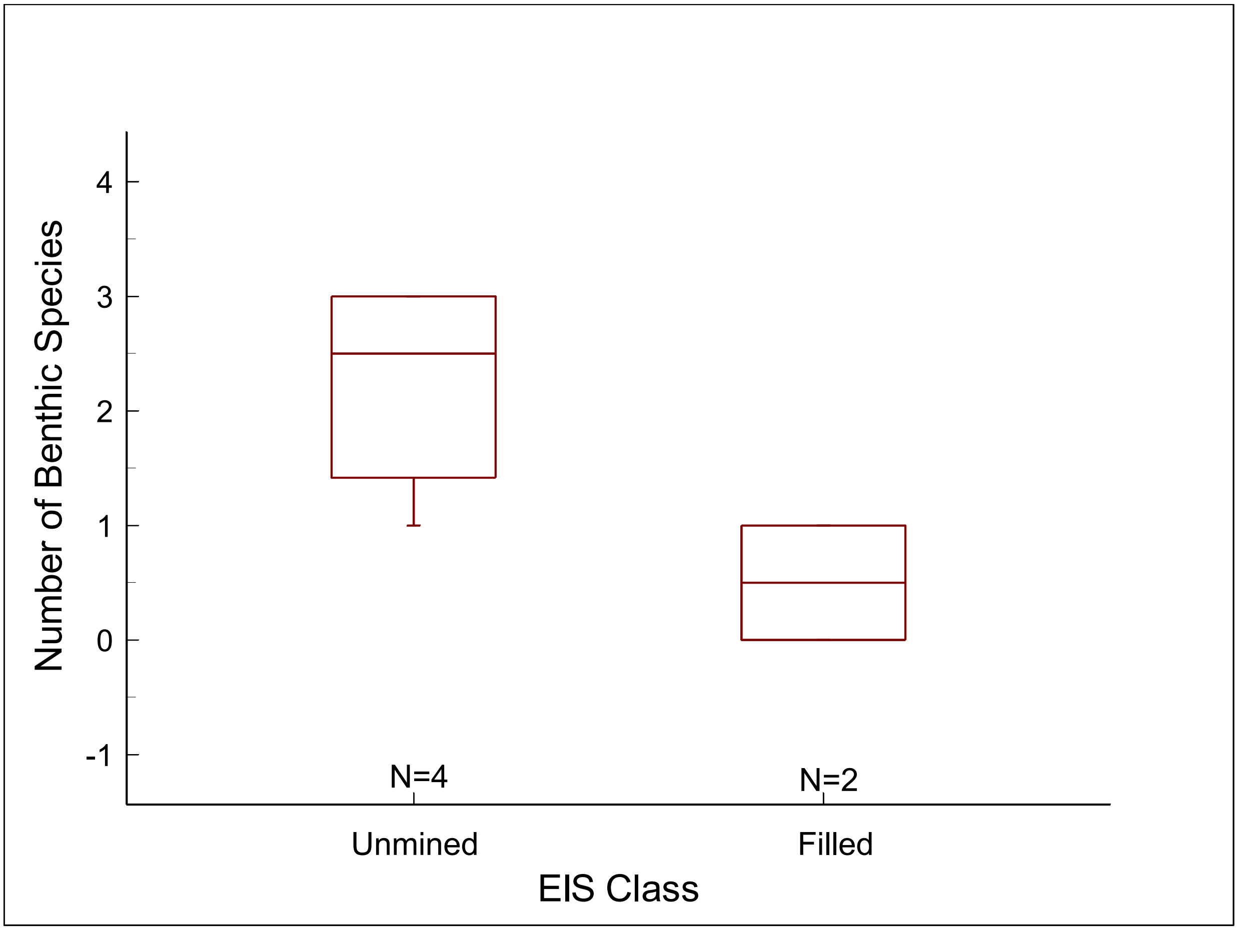

Figure 8. Comparison total number of benthic species between unmined (EIS Class=0) and filled (EIS = 2) sites in second order streams in Twentymile Creek watershed, West Virginia.

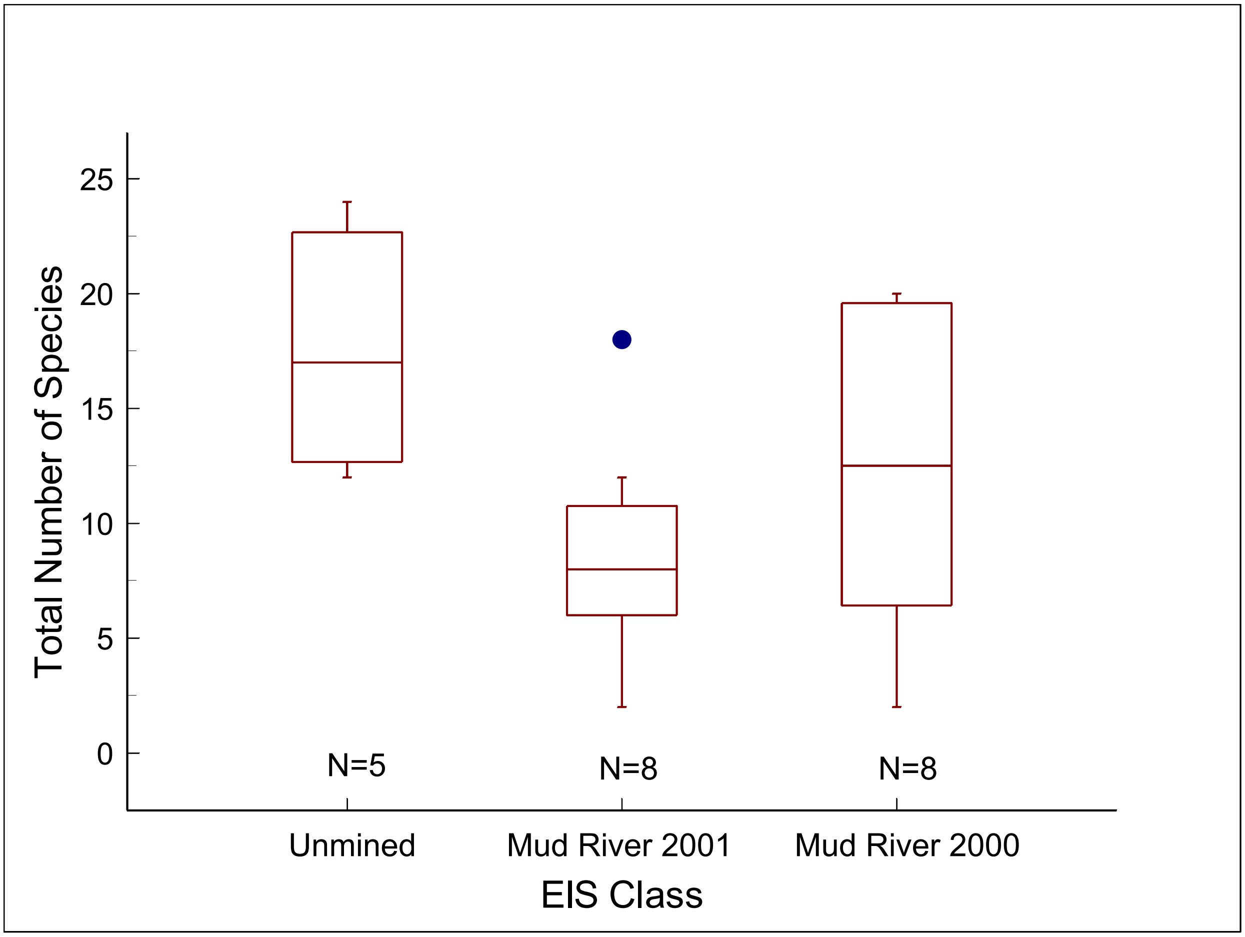

Figure 9. Comparison of total number of species between unmined (EIS Class=0) in the Big Ugly watershed and combined filled (EIS = 2) and filled/residential (EIS=3) sites in the Mud River watershed, West Virginia. The eight sites in the Mud River were sampled both in Fall 2001 (Mud River 2001) and in Fall 1999 and Spring 2000 (Mud River 2000). Sites in the Big Ugly were only sampled in Fall 2001. Comparison of collections in unmined and filled sites in Fall 2001 indicate that unmined sites had greater number of species than filled sites (unmined median = 17, filled (Mud River 2001) = 8, Mann-Whitney U Test P=0.0093).

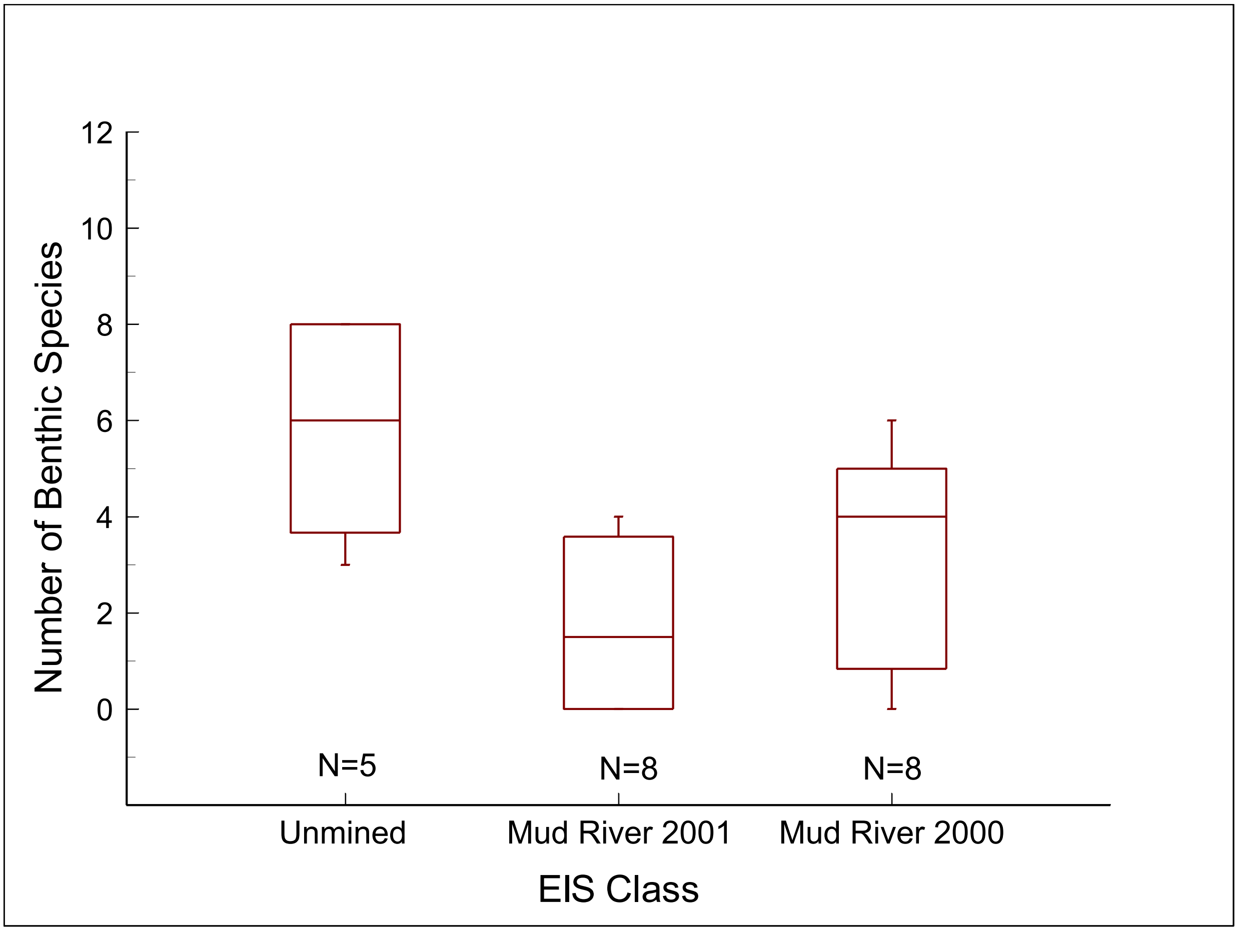

Figure 10. Comparison of total number of benthic species between unmined (EIS Class=0) in the Big Ugly watershed and combined filled (EIS = 2) and filled/residential (EIS=3) sites in the Mud River watershed, West Virginia. The eight sites in the Mud River were sampled both in Fall 2001 (Mud River 2001) and in Fall 1999 and Spring 2000 (Mud River 2000). Sites in the Big Ugly were only sampled in Fall 2001. Comparison of collections in unmined and filled sites in Fall 2001 indicate that unmined sites had greater number of benthic species than filled sites (unmined median = 6, filled (Mud River 2001) = 1.5, Mann-Whitney U Test P=0.0088).

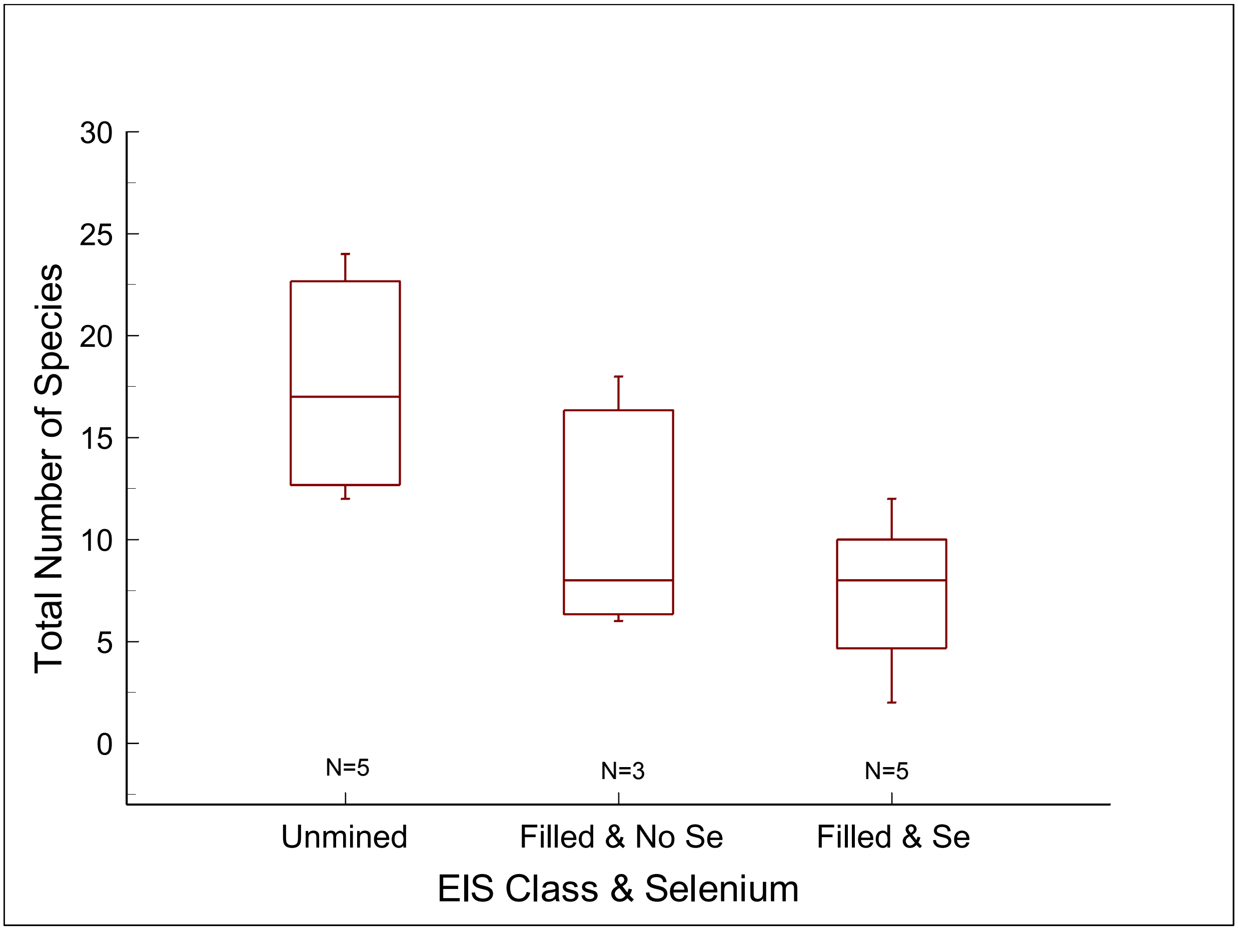

Figure 11. Comparison total number of species collected in Fall 2001 in the Big Ugly and Mud River watersheds. Sites in the Big Ugly were unmined (EIS Class=0) and had no detectable selenium. Sites in the Mud River were a combination of filled (EIS = 2) and filled/residential (EIS=3) categories. Three stations sampled in Fall 2001 in the Mud River did not have detectable levels of selenium (PSU stations 12, 19, 20) while five sites had detectable levels of selenium (PSU stations 7, 17, 18, 22, 23). Total number of species was dramatically lower in sites classified as filled with selenium (median = 8, Mann-Whitney U Test P=0.008) and sites classified as filled without selenium (median = 8, Mann-Whitney U Test P=0.0179) than in unmined sites (median = 17).

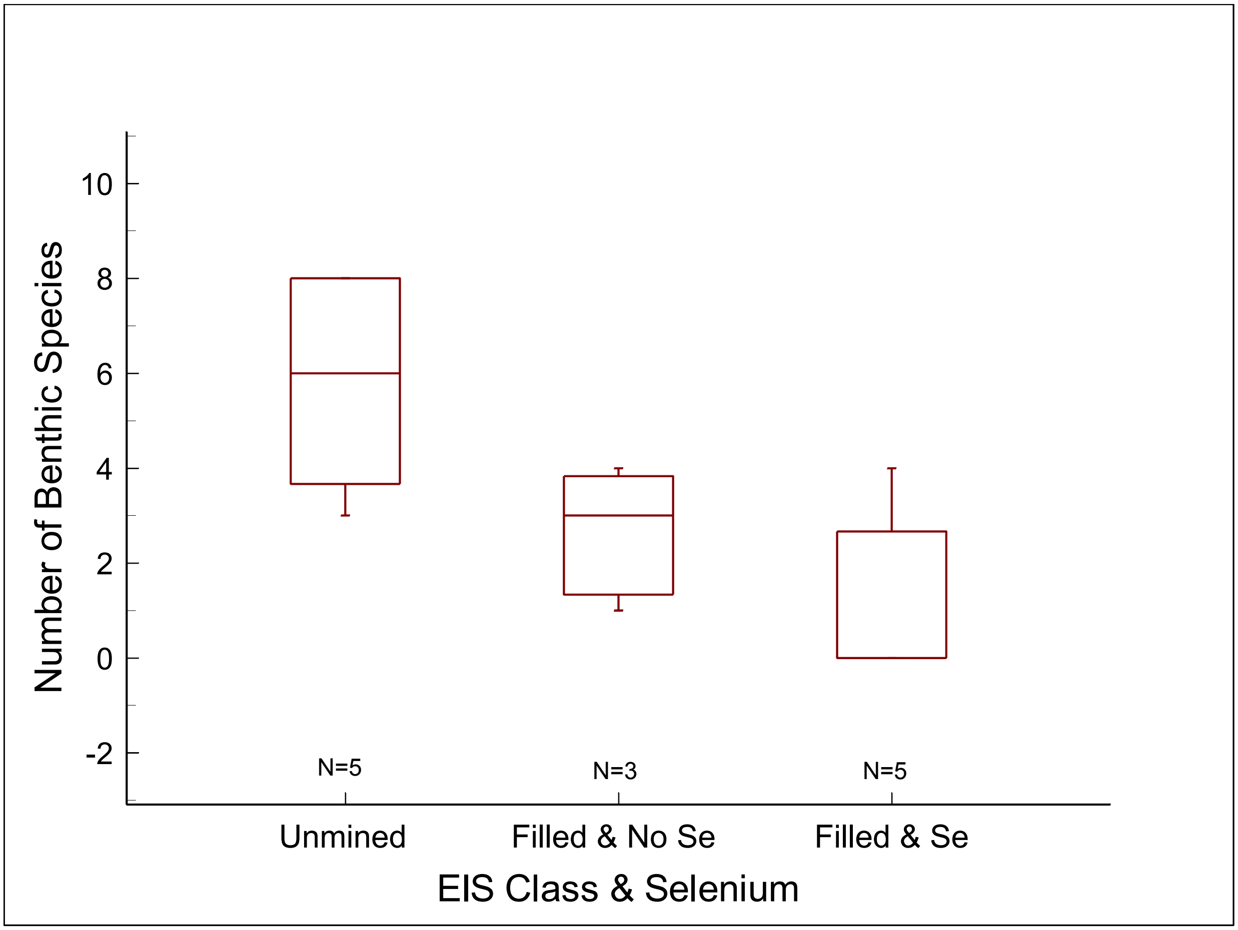

Figure 12. Comparison total number of benthic species collected in Fall 2001 in the Big Ugly and Mud River watersheds. Sites in the Big Ugly were unmined (EIS Class=0) and had no detectable selenium. Sites in the Mud River were a combination of filled (EIS = 2) and filled/residential (EIS=3) categories. Three stations sampled in Fall 2001 in the Mud River did not have detectable levels of selenium (PSU stations 12, 19, 20) while five sites had detectable levels of selenium (PSU stations 7, 17, 18, 22, 23).

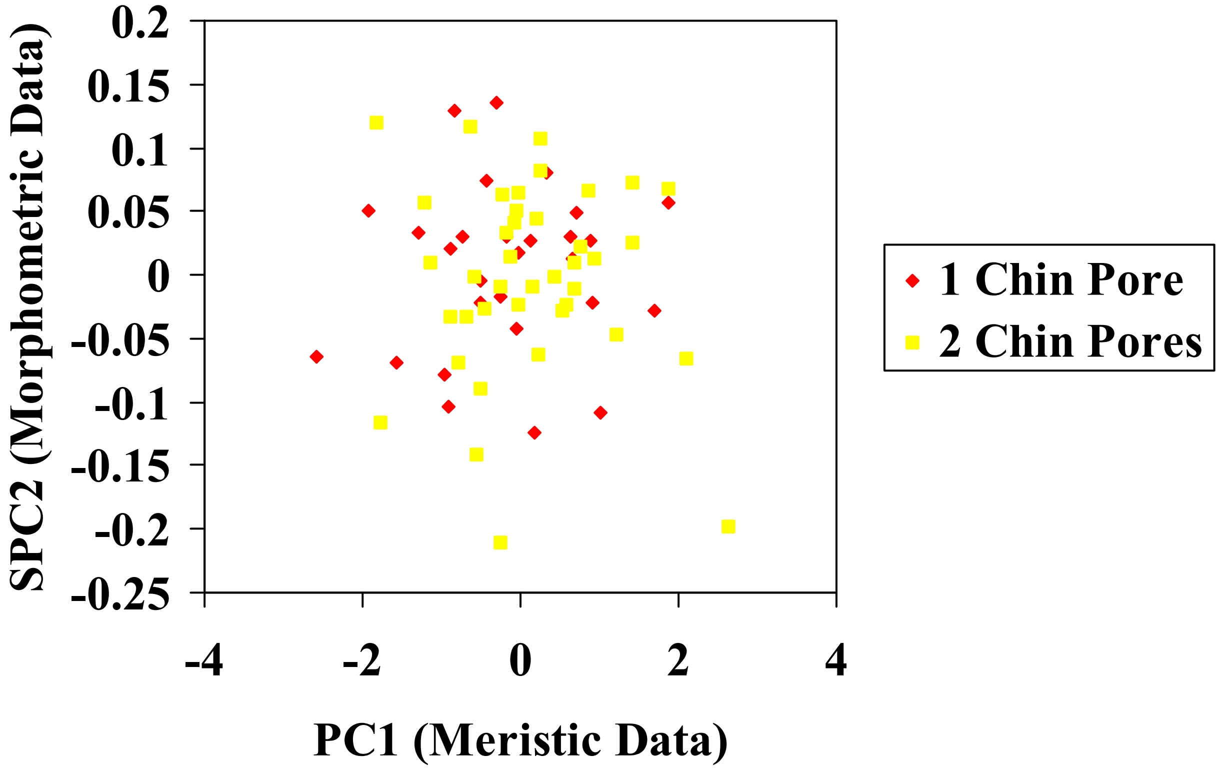

Figure 13. Sheared second principle component (morphometric data) vs first principle component (meristic data) of *Cottus bairdi* populations.

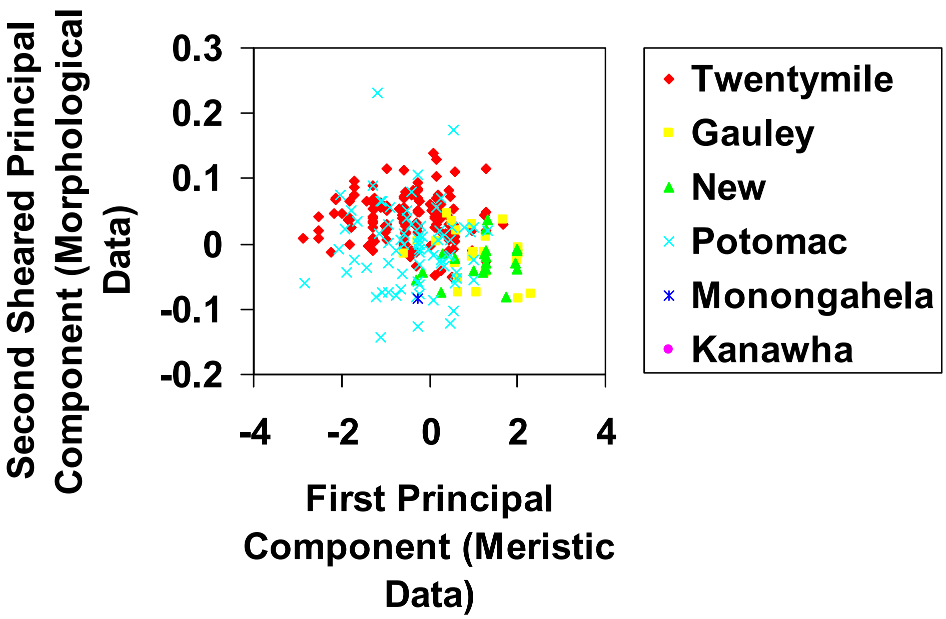

Figure 14. Sheared second principle component (morphometric data) vs first principle component (meristic data) of *Nocomis micropogon* populations.

APPENDIX A: Distribution, life history, and biology information for the 56 species collected in the primary region of MTM/VF coal mining in West Virginia and Kentucky during Fall 1999/Spring 2000 and Fall 2001. Species are listed in phylogenetic order.

Lampetra aepyptera (Abbott), Least Brook Lamprey.
The least broook lamprey superficially resembles the American brook lamprey (*Lampetra appendix*), but the former has fewer than 62 myomeres, and its teeth are poorly developed or missing. The least brok lamprey is found along the Atlantic Slope from North Carolina to Pennsylvania and west of the Appalachian Mountains in the Mississippi River basin from Pennsylvania and Alabama west to Missouri and Arkansas (Rhode and Jenkins 1980). It is widespread in West Virginia and has been collected in the Monongahela, Little Kanawha, Kanawha, Big Sandy, and Guyandotte rivers. We found it in this survey in the Guyandotte River drainage at stations 16, 19, 20, 21, which are all located in the Mud River. In Fall 2001, this lamprey was collected at station 20 of the Mud River and stations 74, 75, 77, and 78 of the Big Ugly. This lamprey is a filter feeding, headwater species, of intermediate tolerance to environmental disturbance.

Oncorhynchus mykiss (Walbaum), Rainbow Trout.
The rainbow trout can be distinguished from the brown trout (*Salmo trutta*) because it has dark spots on its caudal fin, which are absent from the brown trout's; the rainbow trout's body bears a longitudinal reddish stripe, whereas the brown trout's has orange or red spots; the former has 10-12 anal-fin rays, while the brown trout typically has nine. The rainbow trout can be distinguished from the brook trout (*Salvelinus fontinalis*), because the rainbow trout is light with brown or black spots; whereas the brook trout's back has light vermiculations. The rainbow trout's natural distribution encompasses northwest Asia and the Pacific Coast of North America. In West Virginia, it has been introduced statewide. We found it at one station in Spruce Fork (station 44; Kanawha River drainage) in this survey.

Salmo trutta Linnaeus, brown trout.
The absence of spots on the caudal fin of the brown trout distinguishes it from the rainbow trout, which possesses caudal spots. The brown trout can be distinguished from the brook trout (*Salvelinus fontinalis*), because the brown trout is light with brown or black spots; whereas the brook trout's back has light vermiculations. Brown trout are native to Europe and western Asia. In West Virginia, fingerlings and catchable trout have been stocked extensively. We collected three specimens in Toney Fork (station 36) of the Kanawha River drainage. The brown trout was not included in the calculations of species richness and total numbers because although it was collected in Toney Fork, it was taken the stream reach outside of the measured sampling area.

Campostoma anomalum (Rafinesque), Central Stoneroller.
Adult central stonerollers superficially resemble *Nocomis* spp. and juvenile white suckers (*Catostomus commersoni*). The stonerollers can be readily distinguished from all of these by the presence of a cartilaginous plate on their lower lips and their lack of barbels. The central stoneroller is widely distributed over the eastern two-thirds of the United States. It is present from New York south to Alabama and Louisiana, west to the Red River of North and South Dakota, and north to the Upper Mississippi River in Minnesota. In West Virginia, it is

common and often locally abundant in all of the major river systems. We collected it throughout the New, Guyandotte, Kanawha, and Kentucky drainages. This minnow is an herbivore of intermediate tolerance.

Clinostomus funduloides Girard, Rosyside Dace.
The rosyside dace is an elongate minnow that is compressed laterally. It is most easily confused with the redside dace (*Clinostomus elongatus*). The rosyside dace has less than 55 scales along its lateral row, while the redside dace has 60 or more. The rosyside dace occurs in the Atlantic Slope drainages from the Delaware River south to the Savannah River of Georgia. It is also found in the tributaries of the Ohio River in Ohio and West Virgina and tributaries of the Tennessee and Cumberland rivers in Tennessee and Kentucky. In West Virginia, the rosyside dace is found in the Shenandoah River, in the South Fork of the Potomac River, and in the James, Monongahela, New, Guyandotte, and Big Sandy drainages. We collected it at three stations (11, 16, 17) during the 1999/2000 season and two stations (20 and 77) in Fall 2001 in the Guyandotte River drainage. This minnow is a headwater species, an insectivore, a simple lithophil, of intermediate tolerance to environmental disturbances.

Cyprinella galactura (Cope), Whitetail Shiner.
The whitetail shiner superficially resembles other members of *Cyprinella*, but can be spearated from all other species in this genus by the presence of an hourglass-shaped white spot at the base of its caudal fin. The whitetail shiner as a disjunct distribution. It is found in Arkansas and Missouri west of the Mississippi River and in Tennessee and Cumberland rivers east of the Mississippi River. It also occurs in the New River drainage of Virginia and West Virginia, but these populations are believed to be introduced. We collected it at one location (station 54) in Twentymile Creek in the New River drainage. In Fall 2001, we collected it at one station (74) in the Big Ugly watershed (Guyandotte Drainage).

Cyprinella spiloptera (Cope), Spotfin Shiner.
The spotfin shiner can be distinguished form the whitetail shiner because it lacks the hourglass-shaped white spot at the base of its caudal fin. It can be delineated from other *Cyprinella* species, becausethe melanophores on its dorsal fin are concentrated in the posterior 3-4 membranes, whereas these melanophores are found throughout all of the membranes in the other species in this genus. The spotfin shiner usually has eight anal-fin rays, while the others usually have nine. The spotfin shiner occurs from the Potomac River to the Hudson River on the Atlantic Slope, throughout the lower Great Lakes, and in the upper Mississippi Valley south to the Tennessee River drainage in Alabama and the Arkansas River drainage in Oklahoma. In West Virginia, it is found statewide, being absent only from the James River drainage. We collected one specimen at station 45 in Spruce Fork of the Kanawha River drainage. The spotfin shiner is an insectivore with intermediate tolerance to environmental stress.

Cyprinus carpio Linnaeus, Common Carp.
The common carp is a large minnow with a thick, laterally-compressed body and two pairs of barbels on the upper jaws. The common carp is native to temperate Asia and portions of Europe. It is has been introduced to much of North America. In West Virginia, it occurs in

all of the major drainages. We collected one specimen at station 42 in Spruce Fork of the Kanawha River basin. The common carp is an omnivore that is tolerant to environmental stress.

Ericymba buccata Cope, Silverjaw Minnow.
The silverjaw minnow is most easily confused with the sand, mimic, and bigmouth shiners (*Notropis ludibundus, Notropis volucellus,* and *Notropis dorsalis*, respectively). It can be distinguished from all three of these species by virtue of its greatly enlarged suborbital canals, which appear as large, honey-comb-shaped spaces. The silverjaw minnow occurs from the Apalachicola drainage of Florida west to the Pearl River drainage of Mississippi/Louisiana. Further north, it occurs from the Suspuehanna and Potomac rivers west to the Mississippi River drainage in Illinois. It is common throughout the upper Ohio Valley. There is one record from the upper Tennessee River drainage and this possibly represents a remnant population. In West Virginia, the silverjaw minnow is found statewide. We collected it at eight stations in the Guyandotte River drainage, one in the Kanawha River drainage, and at two sites in Kentucky. In Fall 2001, we collected this minnow in two Mud River stations (19, 20), all five Big Ugly stations (74-78), and one Guyandotte station (79). This minnow is considered a pioneering species; it is an insectivore with intermediate tolerance to environmental stress.

Luxilus albeolus (Jordan), White Shiner.
The white shiner is most easily confused with the common shiner, *Luxilus cornutus* and the striped shiner, *Luxilus chrysocephalus*. It can be distinguished from the common shiner by its lack of crowded pre-dorsal scales. The presence of three or four parallel dark bands, which converge at the mid-dorsal line in the striped shiner, are absent in the white shiner. The white shiner is present on the Atlantic slope from the Roanoke River drainage of Virginia south to the Cape Fear River drainage of North Carolina. The white shiner also occurs in the New River drainage of North Carolina, Virginia, and West Virginia, where it was possibly introduced. We collected it at three localities (stations 54, 57, 58) in Twenty Mile Creek of the New River drainage.

Luxilus chrysocephalus (Rafinesque), Striped Shiner.
The striped shiner is most similar to the common shiner and the white shiner. It can be distinguished from the former by virtue of its heavier chin pigmentation and its lack of crowded pre-dorsal scales. It can be distinguished from the white shiner, because the striped shiner has 3-4 parallel dark bands, which converge on the mid-dorsal line. The striped shiner occurs from the lower Great Lakes basin south throughout the Ohio River drainage, south throughout the Mississippi River Valley, and east along the Gulf Coast to the Mobile Bay drainage. In West Virginia, the striped shiner is found in the Potomac drainage and throughout the Ohio River and its tributaries. We collected it at six localities in the Kanawha River drainage, seven localities in the Guyandotte River drainage, two localities in the New River drainages, and at 10 sites in Kentucky. In Fall 2001, we collected this minnow at three Mud River stations (20, 22, 23) and all five Big Ugly stations. This insectivore is a simple lithophil that has intermediate tolerance to environmental stress.

<u>*Lythrurus ardens* (Cope), Rosefin Shiner</u>.
The rosefin shiner has a dark pigment spot on the base of the first several dorsal-fin rays, and 9-11 anal rays. The rosefin shiner occurs on the Atlantic Slope from the York River of Virginia south to the Neuse River of North Carolina. In the Ohio Valley it occurs in the Tennessee River north to the Scioto River of Ohio, and is also present in the new River of Virginia and West Virginia. We collected it in Clear Fork of the Cumberland River and Big Double Creek in the Kentucky River in Kentucky. The rosefin shiner is an insectivore with intermediate tolerance to environmental stress.

<u>*Nocomis micropogon* (Cope), River Chub</u>.
The river chub is most easily confused with other species in this genus. The river chub has only one row of pharyngeal teeth, while the hornyhead chub (*Nocomis biguttatus*) has two. The simple S-shaped intestine of the river chub delineates it from the bluehead chub, *Nocomis leptocephalus*, which has a long coiled intestine. The river chub does not inhabit the New River, where the bigmouth chub, *Nocomis paltyrhynchus* occurs. The river chub occurs from the Susquehanna River drainage in New York south to the James River drainage of Virginia and West Virginia. It is also found throughout the lower Great Lakes and the Ohio River basins. In West Virginia, it occurs statewide, being absent only from the New River. We collected one specimen in Island Creek (station 14) of the Guyandotte River drainage, one specimen from Fugate Fork (station 68) of the Kentucky River in Kentucky. This minnow is an insectivore that is intolerant of environmental stress.

<u>*Nocomis platyrhynchus* Lachner and Jenkins, Bigmouth Chub</u>.
The short S-shaped intestine of the bigmouth chub distinguishes it from the bluehead chub, *Nocomis leptocephalus*, which has a long coiled intestine. It is delineated from all other *Nocomis* species, based on tubercle patterns on the head of breeding males; the bigmouth chub is endemic to the New River system. We collected it at stations 54 and 58 located on Twentymile Creek in the New River drainage. There were some fishes collected in Twentymile Creek that appeared to resemble *Nocomis micropogon*. Not enough males with breeding tubercles were collected to identify these fishes. We did a shape analysis of these specimens and compared them with known populations of *N. micropogon* (Fig. 14). Again, these data were equivocal; hence we identified all specimens collected in Twentymile Creek as *N. platyrhynchus*, but more analyses of these populations are needed.

<u>*Notropis ludibundus* (Girard), Sand Shiner</u>.
The sand shiner superficially resembles the ghost shiner (*Notropis buchanani*) and the mimic shiner (*Notropis volucellus*). It can be separated from both of these species, because the anal-fin of the sand shiner has only seven rays, while the other two species have eight anal rays. The sand shiner occurs from the Rio Grande River of Texas north through the Mississippi Valley and the lower Great Lakes basin. In West Virginia, the sand shiner occurs throughout the Ohio River drainage. We collected it at three localities in the Guyandotte River drainage and two localities in the Kanawha River basin. In Fall 2001, we collected it in one Mud River station (22) and two Big Ugly stations (74, 75). The sand shiner is an insectivore with intermediate tolerance to environmental stress.

Notropis photogenis (Cope), Silver Shiner.
The silver shiner can be delimited from all other *Notropis* species in the study area because it has nine pelvic-fin rays, and all other *Notropis* species have 8 pelvic-fin rays. The silver shiner is present in the western portion of the Lake Erie basin and the Grand River of Ontario. It is found throughout most of the Ohio River drainage south to the Tennessee river. In West Virginia, the silver shiner is found in all of the major Ohio River tributaries. We collected it at stations 42-45 in the Kanawha River drainage. The silver shiner is an insectivorous lithophil that is intolerant of environmental stress.

Notropis rubellus (Agassiz), Rosyface Shiner.
The rosyface shiner can be delimited from all other *Notropis* species because its insertion of the dorsal fin is posterior to the pelvic-fin insertion. The rosyface shiner occurs from the Great Lakes Basin and upper Mississippi Valley south to the Tennessee and Missouri river drainages. There is an isolated population in the Ouachita River drainage of Arkansas. In West Virginia, it occurs in every major river drainage. The New River population is distinct and will probably be described as a separate species (Mayden, personal comm.). We collected it from five sites in the Kanawha River basin, one site in the Guyandotte River basin, one site in the New River basin, and at four sites in Kentucky. In Fall 2001, we collected it in two Big Ugly stations (74, 75). The rosyface shiner an insectivorous lithophil that is intolerant to environmental stress.

Notropis telescopus (Cope), Telescope Shiner.
The telescope shiner can be recognized by the presence of an irregular scale pattern on the first one or two scale rows. It occurs in the upland areas of the Mississippi Valley from the White River of Arkansas south to the Tennessee River in Alabama and east to the Cumberland River drainage in Virginia. In West Virginia, the telescope shiner is restricted to the Kanawha, and Big Sandy rivers. We collected it at two sites (stations 54 and 58) in Twentymile Creek in the New River drainage.

Notropis volucellus (Cope), Mimic Shiner.
The mimic shiner can be easily confused with the sand and ghost shiners. It can be distinguished from the sand shiner, because it has eight anal-fin rays, while the sand shiner only has seven. Its pelvic fins are shorter than the ghost shiner's and reach the anal-fin origin. We collected the mimic shiner at one station (54) in the New River drainage, 2 stations in the Kanawha River drainage, and at two stations in Kentucky. The mimic shiner is an insectivore that is intolerant to environmental stress.

Phoxinus erythrogaster (Rafinesque), Southern Redbelly Dace.
The southern redbelly dace is most easily confused with the mountain redbelly dace (*Phoxinus oreas*). It can be distinguished from the mountain redbelly dace, because the southern redbelly dace has two parallel lateral stripes along the entire length of its body, whereas the mountain redbelly dace has lateral stripes, which are not parallel and do not extend along the entire length of its body. The southern redbelly dace is widely distributed from southern Minnesota and Wisconsin east ot western Pennsylvania and south to Alabama and northern Arkansas. There are isolated populations in the upper Arkansas River of New Mexico and along the Mississippi River in Mississippi. In West Virginia, the southern

redbelly dace is found in the small headwater streams in the Ohio River drainage. We collected it at station 26 in Buffalo Fork in the Kanawha River drainage and at two localities (stations 61, 63) in Kentucky. This minnow described as an herbivorous headwater species that is a simple lithophil and has an intermediate tolerance to environmental stress.

Pimephales notatus (Rafinesque), Bluntnose Minnow.
The bluntnose minnow can be distinguished from the fathead minnow because the bluntnose minnow has a slimmer body and a complete lateral line. It can be separated from other minnows in West Virginia on the basis of its crowded pre-dorsal scales. The bluntnose minnow is widely distributed throughout the Mississippi Valley and Great Lakes. Atlantic Coast populations occur from Virginia to Quebec. It is found in all of the major drainages of West Virginia, with the exception of the James. We collected it at two localities in the Kanawha River drainage, three in the New River drainage, seven in the Guyandotte, and at nine localities in Kentucky. In Fall 2001, we collected this minnow at three Mud River stations (12, 19, 20), all five Big Ugly stations (74-78), and one Guyandotte station (79). This minnow is an omnivorous pioneering species that is tolerant to environmental stress.

Pimephales promelas Rafinesque, Fathead Minnow.
The fathead minnow can be distinguished from other *Pimephales* species, because an incomplete lateral line and a more robust body. The fathead minnow is distributed throughout most of North America. In West Virginia, it can be found in all of the major drainages. It is used as a bait fish and, as such, has been introduced widely. We collected it in Stanley Fork (station 18) in the Guyandotte River during the 1999/2000 season and at two stations (17 and 18) during the 2001 season. This omnivorous minnow is a pioneering species that is tolerant of environmental stress.

Rhinichthys atratulus (Hermann), Blacknose Dace.
The blacknose dace is most easily confused with the longnose dace (*Rhinichthys cataractae*) from which is differs because the blacknose dace lacks a fleshy snout hanging over its mouth. The blacknose dace occurs from Nova Scotia west throughout the Great Lakes and upper Mississippi River drainages and south to Tennessee, Georgia, and Alabama. In West Virginia, the blacknose dace is found in all of the major river drainages. We collected it at 18 localities in the Guyandotte River drainage, 19 sites in the Kanawha River drainage, eight sites in the New River drainage, and at five stations in Kentucky. During Fall 2001, we collected this minnow at two Mud River stations (19, 20), three Big Ugly stations (76, 77, 78), and all three Guyandotte stations (79, 80, 81). The blacknose dace is described as a generalist, headwater, lithophilous, minnow that is tolerant to environmental stress.

Semotilus atromaculatus (Mitchill), Creek Chub.
The creek chub is a large minnow with a robust body and a broad, stout head. The creek chub occurs throughout much of the United States from Montana and New Mexico east to the Atlantic Coast. In West Virginia, it is found in all of the major drainages. We collected it 17 localities in the Guyandotte River drainage, at 17 localities in the Kanawha River drainage, at 11 localities in the New River drainage, and at 14 localities in Kentucky. During Fall 2001, the creek chub was collected at all stations. The creek chub is a generalist pioneering minnow that is tolerant of environmental stress.

Catostomus commersoni (Lacepede), White Sucker.
The white sucker superficially resembles the longnose sucker (*Catostomus catostomus*). The two can be distinguished form each other because the white sucker has 55-85 lateral-line scales, whereas the longnose sucker has 98-108. The white sucker is found throughout Canada south to New Mexico and Georgia. In West Virginia, it is found in all of the major drainages. We collected it at three stations in the Kanawha River drainage, 10 stations in the Guyandotte, six localities in the New River drainage, and four sites in Kentucky. During Fall 2001, white suckers were collected at four Mud River stations (12, 17, 20, 23), one Big Ugly (77), and one Guyandotte station (79). The white sucker is described as an omnivorous lithophil that is tolerant of environmental stress.

Hypentelium nigricans (LeSueur), Northern Hog Sucker.
The combination of a short dorsal fin (< 18 rays), a complete lateral line, and a head, which is concave between the eyes distinguishes the northern hog sucker from all other suckers in our study. The northern hog sucker occurs throughout the Mississippi River system, the Great Lakes region, and the Atlantic Slope from New York to northern Georgia. In West Virginia, the northern hog sucker occurs in virtually all stream systems. We collected it at eight localities in the Guyandotte River drainage, nine stations in the Kanawha River drainage, 10 sites in the New River drainage, and 10 sites in Kentucky. In Fall 2001, we collected it in two Mud River stations (18, 22), four Big Ugly stations (74, 75, 77, 78), and one Guyandotte station (79). The northern hog sucker is an insectivorous lithophil that is intolerant to environmental stress.

Moxostoma erythrurum (Rafinesque), Golden Redhorse.
The golden redhorse superficially resembles several of the large redhorse suckers (*Moxostoma* spp.) in West Virginia. Its slate-colored tail distinguishes it from both the river redhorse (*Moxostoma carinatum*) and the Ohio shorthead redhorse (*Moxostoma macrolepidotum breviceps*). The northern shorthead redhorse (*Moxostoma macrolepidotum macrolepidotum*), which has a slate-colored tail has a medial bulb on its upper lip that the golden redhorse lackes. The number of lateral-line scales present in the golden redhorse (39-43) separates it from the black redhorse (*Moxostoma duquesnei*), which has 44-47. The golden redhorse is widely distributed throughout the Mississippi River north to the Great Lakes. An isolated population (possibly introduced) is found in the Potomac River. In West Virginia, the golden redhorse occurs in all of the major drainages except the James River. We collected it at three sites in the Guyandotte River drainage, at one site in the Kanawha River drainage, and at one site in Kentucky. During Fall 2001, it was only collected at one station in the Big Ugly watershed (station 74). The golden redhorse is described as an insectivorous lithophil that is moderately tolerant to environmental stress.

Ameiurus melas (Rafinesque), Black Bullhead.
The black bullhead differs from the yellow bullhead (*Ameiurus natalis*) in having brown or black chin barbells and a slightly forked or rectangular caudal fin. It is distinguished from the brown bgullhead (*Ameiurus nebulosus*) because it lacks strongly barbed pectoral fins and usually has fewer anal-fin rays (16-22) than does the brown bullhead (21-24). The black bullhead is native from southern Canada, Montana, and northern Mexico east to the Saint Lawrence River, the Appalachian Mountains, and Alabama. In West Virginia, it is found in

the main channel and greater Ohio River. It occupies both lotic and lentic areas throughout its range. It prefers silty water and is not able to populate the cool, clear waters inhabited by brown and yellow bullheads. In this survey, we collected one specimen at one station in the Mud River watershed (station 17) during Fall 2001.

Ameiurus natalis (LeSueur), Yellow Bullhead.
The yellow bullhead has yellow/white chin barbels, while both the brown bullhead (*Ameiurus nebulosus*) and the black bullhead (*Ameiurus melas*) have brown to black chin barbels. The yellow bullhead's caudal fin in slightly rounded, while the brown bullhead's caudal fin has a straight posterior margin. The yellow bullhead is indigenous to central and eastern North America. In West Virginia, it occurs in both the Ohio and Atlantic Slope drainages. We collected it at three localities in the Guyandotte River drainage and at one locality in Kentucky. In Fall 2001, we collected it at two Mud River stations (22, 23). The yellow bullhead is described as a tolerant insectivore.

Ameiurus nebulosus (LeSueur), Brown Bullhead.
The brown bullhead can be distinguished from the yellow bullhead (*Ameiurus natalis*) because the brown bullhead has brown or black barbels, wheras the yellow bullhead has white/hellow barbells. Strongly-barbed pectoral spines and 21-24 anal-fin rays distinguish the brown bullhead from the black bullhead (*Ameiurus melas*), which has 16-20 anal-fin rays and weakly-barbed pectoral spines. The brown bullhead is native to eastern North America, but it has been widely introduced outside its native range. In West Virginia, it is found in the Potomac and Ohio River drainages. It occurs in both lentic and lotic habitats, in associated with moderate amounts of aquatic vegetation, and prefers clearer, cooler water than do other *Ameiurus* species. We collected one specimen at one station in the Mud River watershed (station 18) in Fall 2001.

Noturus miurus Jordan, Brindled Madtom.
The brindled madtom can be distinguished from other *Noturus* species, because it posseses a curved pectoral spine with anterior and posterior serrae, and it has three bold, distinct blotches on its dorsal surface. The brindled madtom is native to the portions of the Gulf Slope, including the Mississippi River through the Ohio River basin and throughout the lower parts of Lake Erie and Lake Ontario drainages. In West Virginia, it occurs throughout the Ohio River basin. We collected one specimen at one site (station 22 in Spring 2000) in the Mud River during the 1999/2000 season and four specimens at one site in the Big Ugly (station 74) in Fall 2001 (both in Guyandotte River drainage). The brindled madtom is an intolerant benthic insectivore.

Labidesthes sicculus (Cope), Brook Silverside.
The brook silverside superficially resembles a slender minnow. It can be distinguished, however, by its beak-like snout and the presence of two clearly separted dorsal fins. The brook silverside is widely distributed throughout the Mississippi Valley, including all of the Ohio River drainage. It is also present throughout the lower Great Lakes basin, the Atlantic Slope from South Carolina to Florida, and west along the Gulf Coast to Texas. In West Virginia it is found throughout the Ohio River basin and is most common in the Little Kanawha River, the West Fork of the Monongahela River, and in Twelvepole Creek. We

found the brook silverside at only one station in the Mud River watershed (station 20) during Fall 2001. Brook silversides prefer pool areas of streams and quiet areas of lakes with an abundance of aquatic vegetation.

Cottus bairdi Girard, Mottled Sculpin.
The mottled sculpin can be distinguished from the Potomac sculpin (*Cottus girardi*) and the banded sculpin (*Cottus carolinae*) because the mottled sculpin's chin is uniformaly colored, whereas those of the latter two species have distinct blotches. The mottled sculpin can be distinguished from the slimy sculpin (*Cottus cognatus*) because it has 4 pelvic-fin rays, as opposed to three. The mottled sculpin usually has two medial chin pores. In several of the populations that we sampled, we found an almost equal number of mottled sculpins with either one or two chin pores. The mottled sculpin's native range is discontinuous throughout North America with populations occurring from Canada south to Georgia, Alabama, and New Mexico. In West Virginia, it is found in all of the major drainages. The mottled sculpin is an intolerant, benthic, headwater insectivore.

Ambloplites rupestris (Rafinesque), Rock Bass.
The rock bass superficially resembles crappies (*Pomoxis* spp.), warmouths (*Lepomis gulosus*), and green sunfish (*Lepomis cyanellus*). It differs from all *Lepomis* species in having five to eight anal spines, instead of three. The rock bass has 10-13 dorsal-fin spines, whereas *Pomoxis* species have six to eight. The rock bass occurs from northern Georgia north to southern Ontario and west to the western tributaries of the Mississippi River. In West Virginia, it occurs in all of the major drainages. We collected it in the Guyandotte, Kanawha, New, and Kentucky drainages. During Fall 2001, we collected it in one Mud River site (23) and three Big Ugly sites (74, 75, 78). The rock bass is a piscivore that exhibits intermediate tolerance to environmental stresses.

Lepomis auritus (Linnaeus), Redbreast Sunfish.
The redbreast sunfish superficially resembles the bluegill (*Lepomis macrochirus*), because these are the only two *Lepomis* species that have a black margin to its opercular spot. It differs from the bluegill, because the redbreast sunfish lacks the black spot, which is present at the posterior base of the bluegill's dorsal fin. The redbreast sunfish is native to the Atlantic Slope from southern Canada to central Florida, and west to the Apalachicola River. It has been widely introduced outside of its native range. We collected it at only two sites in the Cumberland River drainage in Kentucky. The redbreast sunfish is described as an insectivore with intermediate tolerance to environmental stresses.

Lepomis cyanellus Rafinesque, Green Sunfish.
The green sunfish resembles the warmouth (*Lepomis gulosus*), but unlike the warmouth's tongue, the tongue of the green sunfish bears no teeth. The green sunfish can be distinguished from all other *Lepomis* species because the green sunfish possesses a large mouth, the maxilla of which, extends to or beyond the middle of the eye. We collected it in all of the major drainages that we sampled. In Fall 2001, the green sunfish was caught at seven of the Mud River stations, but it was not caught at any of the Big Ugly reference stations. The green sunfish is described as a pioneering insectivore that is tolerant to environmental stresses.

Lepomis gibbosus (Linnaeus), Pumpkinseed.
The pumpkinseed can be distinguished from the longear sunfish (*Lepomis megalotis*) and the redear sunfish (*Lepomis microlophus*) because the pumpkinseed's opercle is stiff to its bony margin. It differs from other *Lepomis* species because its gill rakers are short and thick. The pumpkinseed is native to the Atlantic Slope drainages from Canada to northern Georgia, and west throughout the Great Lakes drainages and upper Mississippi River basin. In West Virginia, it is found in most of the major drainages. It appears to prefer cooler water than do most of the other *Lepomis* species. We collected it in one site of the Big Ugly watershed (station 75) during Fall 2001.

Lepomis macrochirus Rafinesque, Bluegill.
Only the bluegill and the redbreast sunfish have an opercular spot that is black to its margin. The black spot at the posterior base of the bluegill's dorsal fin distinguishes it from the redbreast sunfish. The bluegill is native to eastern and central North America from Virginia to Florida, west to Texas and northern Mexico, and north to western Minnesota and western New York. It has been introduced throughout North America, Europe, and South Africa. The bluegill is widely distributed throughout West Virginia and has been collected in all of the major drainages. We collected it in the Guyandotte and Kanawha rivers and at the sites in Kentucky. In Fall 2001, we collected it at three Mud River sites and one Big Ugly site. The bluegill is an insectivore that demonstrates intermediate tolerance to environmental stresses.

Lepomis megalotis (Rafinesque), Longear Sunfish.
The longear sunfish resembles the pumpkinseed sunfish (*Lepomis gibbosus*) and the redear sunfish (*Lepomis microlophus*). It differs from the pumpkinseed sunfish because the longear sunfish's opercle is flexible at its margin, whereas the pumpkinseed's is stiff to its bony margin. The longear sunfish as short pectoral fins, while the redear's are long, extending beyond the eye when laid forward. The longear sunfish is widely distributed throughout the Mississippi River basin and long the Gulf Slope from western Florida to Texas; it is patchily distributed in the Great Lakes drainages. The longear sunfish is distributed throughout West Virginia, being only absent from the James River. We collected it in the Guyandotte and Kentucky river drainages. During Fall 2001, we collected it at two Mud River sites and four Big Ugly sites. The longear sunfish is described as an insectivore with intermediate tolerance to environmental stresses.

Micropterus dolomieu Lacepede, Smallmouth Bass.
The lack of a dark mid-lateral band distinguishes the smallmouth bass from both the spotted bass (*Micropterus punctulatus*) and the largemouth bass (*Micropterus salmoides*). The smallmouth bass is native to the Great Lakes drainages and the Mississippi River basin. It has been introduced throughout the world. In West Virginia, it occurs in all of the major drainages. We caught it in the Kanawha, Guyandotte, and Kentucky drainages. During Fall 2001, we only caught it at four of the Big Ugly reference sites. Smallmouth bass are piscivores with intermediate tolerance to environmental stresses.

Micropterus punctulatus (Ranfinesque), Spotted Bass.
The spotted bass can be distinguished from the smallmouth bass (*Micropterus dolomieu*) because of its dark mid-lateral band. Its unbranched pyloric caeca and the tricolored tails of juveniles distinguish it from the largemouth bass (*Micropterus salmoides*). The spotted bass is indigenous to the central Misissippi River basin from northern Missouri to western Pennsylvania, south to Mississippi and Louisana, and along the Gulf Coast from Texas to western Florida. It has been introduced elsewhere. In West Virginia, the spotted bass is distributed widely throughout the Ohio River drainages. We captured it in the Guyandotte River in West Virginia and the Cumberland River drainages in Kentucky. In Fall 2001, we caught it in two stations in the Mud River and two stations in the Big Ugly. Spotted bass are piscivores with intermediate tolerance to environmental stresses.

Micropterus salmoides (Lacepede), Largemouth Bass.
Two strains of largemouth bass are recognized in North America, a northern strain and a Florida strain. The former is native to West Virginia; members of the latter probably now occur within the state. The largemouth bass can be distinguished from other *Micropterus* species in West Virginia and Kentucky on the basis of its large mouth, the maxilla of which extends behind the eye in adults. The largemouth bass is indigenous to the Mississippi River basin from northeastern Mexico to Florida, and north to the Great Lakes drainages of southern Canada. Its native range on the Atlnatic Slope was restricted to southern Florida north to southern or central South Carolina. It has been introduced throughout the world. In West Virginia, the largemouth bass occurs in all of the major drainages. We collected it in the Guyandotte and Kanawha river drainages. Largemouth bass are piscivores with intermediate tolerance to environmental stresses.

Etheostoma baileyi Page and Burr, Emerald Darter.
The emerald darter is the only member of the subgenus *Ulocentra*, which occurs in the Cumberland River system upstream of the Big South Fork (Etnier and Starnes 1993). The emerald darter is native to the upper Kentucky River and Cumberland river drainages of Kentucky and Tennessee above Cumberland Falls, and in the Rockcastle and Big South Fork systems, below Cumberland Falls (Etnier and Starnes 1993). We collected it throughout the stations sampled in Kentucky. The emerald darter is a benthic lithophilous insectivore that is intolerant of environmental stresses.

Etheostoma blennioides Rafinesque, Greenside Darter.
The greenside darter superficially resembles the banded darter (*Etheostoma zonale*). The greenside darter has a blunt snout and lacks a frenum, unlike the banded darter. The greenside darter is found from Kansas and Oklahoma east to New York, and from Ontario south to Alabama, Georgia, and Arkansas. In West Vriginia, the greenside darter is found in all of the major drainages except for the James River. We collected it throughout all of the major drainages that we sampled. During Fall 2001, we collected it at two sites in the Mud River and three sites in the Big Ugly. The greenside darter is a benthic lithophious insectivore with intermediate tolerance to environmental stresses.

Etheostoma caeruleum Storer, Rainbow Darter.
The rainbow darter superficially resembles the orangethroat darter (*Etheostoma spectabile*). The rainbow darter has red coloration in its anal fin and a complete infraorbital canal, both of which the oragnethroat darter lacks. The rainbow darter occurs primarily in the Great Lakes and Mississippi River drainages, from Minnesota east to New York and south to Arkansas, Alabama, and Georgia. Esmond and Stauffer (1983) reported it from the upper Potomac River in West Virginia. Elsewhere in West Virginia, it is found in the tributaries of thegreater Ohio River. There are no records of this species from the Little Kanawha River. We found it in all of the major drainages that we sampled. In Fall 2001, we found it in both the Mud River and Big Ugly. The rainbow darter is described as a benthic lithophilous insectivore. Barbour et al. (1999) describe this species as having intermediate tolerance to environmental stresses, while Messinger and Chambers (2001) describe it as being intolerant.

Etheostoma flabellare Rafinesque, Fantail Darter.
The fantail darter is the only member of the subgenus *Catonotus* in West Virginia. In Kentucky, it superficially resembles the stripetail darter (*Etheostoma kennicotti*), which had a prominent black submarginal band in the first dorsal fin that the fantail darter lacks (Etnier and Starnes 1993). We collected it in all of the major drainages that we sampled. In Fall 2001, we found it at two Mud River stations and all five Big Ugly stations. This darter is described as a headwater benthic insectivore with intermediate tolerance to environmental stresses.

Etheostoma kennicotti (Putnam), Stripetail darter.
The stripetail darter does not occur in West Virginia. In Kentucky, it superficially resembles the fantail darter (*Etheostoma flabellare*). The presence of a dark submarginal band on the first dorsal fin of the stripetail darter distinguishes it from the fantail darter. It is native throughout much of the Tennessee River drainage, above and below the Cumberland Falls in the Cumberland drainage, and in the Green River drainage of the Ohio River (Etnier and Starnes 1993). We collected it at two sites in the Cumberland River drainage. This darter is described as a benthic headwater insectivore with intermediate tolerance of environmental stresses.

Etheostoma nigrum Rafinesque, Johnny Darter.
The johnny darter resembles both the longfin darter (*Etheostoma longimanum*) and the tessellated darter (*Etheostoma olmstedi*). The johnny darter has one anal-fin spine, while the longfin darter has two. The tessellated darter has an incomplete infraorbital canal and the johnny darter has a complete infraorbital canal. The johnny darter is occurs as far west as Colorado and as far south as Alabama. Although it is mostly restricted to the Mississippi Valley drainages, it does occur in the Atlantic Slope drainages in Canada, Virginia, and North Carolina. In West Virginia, the johnny darter is widely distributed throughout the Ohio River drainages. We collected it in all of the major drainages we sampled. In Fall 2001, we collected it at three Mud River stations and all five Big Ugly stations. The johnny darter is described as a benthic pioneering insectivore with intermediate tolerance to environmental stresses.

Etheostoma sagitta (Jordan and Swain), Arrow Darter.
The arrow darter is distinguished by its pointed snout and the presence of 9-11 dorsal-fin spines. It is native to the Cumberland River drainage and tributaries of the upper Kentucky River system (Etnier and Starnes 1993). We collected it at two localities in Kentucky. The arrow darter is a benthic headwater insectivore.

Etheostoma variatum Kirtland, Variegate Darter.
The variegate darter superficially resembles the candy darter (*Etheostoma osburni*). The variegate darter has four dark saddles, whereas the candy darter as between 5-6. The variegate darter is endemic to the Ohio River drainage. In West Virginia, it is widely distributed throughout this drainage, being absent only from the Kanawha River system above Kanawha Falls (New River). We collected it in the Kanawha River drainages and in Kentucky. In Fall 2001, we collected it at three sites in the Big Ugly watershed. The variegate darter is a benthic lithophilous insectivore that is intolerant of environmental stresses.

Etheostoma zonale (Cope), Banded Darter.
The banded darter superficially resemble the greenside darter (*Etheostoma blennioides*). The banded darter has a frenum, which is lacking in the greenside darter. The banded darter is widely distributed and common throughout the Mississippi River basin from Kansa and Tennessee, north to Minnesota and New York. In West Virginia, the banded darter is found throughout most of the Ohio River drainage, with the exception of the Tygart Valley River and New River drainages. We collected it in the Kanawha and Guyandotte river drainages. During Fall 2001, we collected it at one Mud River station (22) and two Big Ugly stations (74, 75). This darter is a benthic lithophilous insectivore that is intolerant of environmental stresses.

Percina caprodes (Rafinesque), Logperch.
The logperch is distinguished by its subterminal mouth and fleshy conical snout. It is widely distributed throughout the Ohio River basin in central United States, the White River system in the Ozak Mountains, the Red Rvier system in the Ouachita Mountains, the Atchafalaya River system, the upper Mississippi River basin, the Great Lakes, the Hudson Bay drainages, and south along the central Atlantic Coastal Plain rivers. In West Virginia, the logperch is widely distributed throughout the greater Ohio River drainage. We collected it only in the Guyandotte River drainage during both sampling periods. This benthic lithophilous insectivore exhibits intermediate tolerance to environmental stresses.

Percina maculata (Girard), Blackside Darter.
The blackside darter (subgenus *Alvordius*) resembles the Appalachia darter (*Percina gymnocephala*), and the shield darter (*Percina peltata*). The blackside darter lacks the shield darters characteristic chin bar. The Appalachia darter is endemic to New River. The blackdarter is widely distributed throughout the Mississippi River basin, along the Gulf Slope from Louisiana to Alabaama and in the Great Lakes drainages. In West Virginia, it occurs throughout the greater Ohio River, excluding the New River. We collected it in the Guyandotte River in West Virginia and at several sites in Kentucky. During Fall 2001, we

collected it only at four stations of the Big Ugly watershed. This benthic lithophilous insectivore exhibits intermediate tolerance to environmental stresses.

Percina stictogaster, Frecklebelly Darter.
The frecklebelly darter is an undescribed *Percinia* species from the upper Kentucky and Green river drainages in eastern and central Kentucky and north central Tennessee (Page and Burr 1991). We collected it at two localities in Kentucky. The frecklebelly darter is described as a benthic lithophilous insectivore.

APPENDIX B: Tables of catch composition for each collection by drainage basin (Table 1B = Guyandotte River Drainage (Mud River and Island Creek watersheds), Table 2B = Kanawha River Drainage (Spruce Fork and Clear Fork watersheds), Table 3B = New River Drainage (Twentymile Creek watershed), Table 4B = Cumberland and Kentucky River Drainages) during Fall 1999 and Spring 2000.

Table 1B. Total number caught (Number), total biomass (g), biomass per square meter (g/sq.m.), population estimate (based on 3-pass depletion), and the associated upper 95% confidence limit on the estimate (Upper CL) by species for fish collections completed in the Guyandotte River Drainage (Mud River and Island Creek watersheds), West Virginia during Fall 1999 and Spring 2000. NA in the Estimate column indicates samples where an estimate could not be calculated due to too few fish being caught, an irregular depletion pattern, or all fish being caught in the first pass.

Station # 1 **Collection #:** JRS-99-67 **EPA #:** MT-57B **EIS Class:** 2 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
No Fish Caught					

Station # 2 **Collection #:** JRS-99-69 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
No Fish Caught					

Station # 3 **Collection #:** JRS-00-61 **EPA #:** MT-58 **EIS Class:** 2 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	12	31.7	0.12	12	12.2

Station # 4 **Collection #:** JRS-00-62 **EPA #:** MT-52 **EIS Class:** 2 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	14	45.5	0.27	14	14.3

Station # 5 **Collection #:** JRS-00-67 **EPA #:** MT-13 **EIS Class:** 0 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	1	0.1	0.00	NA	
Semotilus atromaculatus	12	95.7	1.59	NA	

Station # 6F **Collection #:**JRS-99-68 **EPA #:** MT-60 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	41	126.6	0.39	41	42.5
Semotilus atromaculatus	18	408.5	1.27	18	20.1

Station # 6S **Collection #:**JRS-00-50 **EPA #:** MT-60 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	22	76.8	0.31	NA	
Semotilus atromaculatus	3	10.3	0.04	NA	

** Only 1 pass completed – repeat of collection made in Fall 1999.

Station # 7 **Collection #:** JRS-00-52 **EPA #:** MT-18 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	2	2.2	0.01	NA	
Semotilus atromaculatus	7	48.7	0.22	7	8.4

Station # 8 **Collection #:** JRS-00-59 **EPA #:** MT-50 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	15	20.7	0.11	19	32.4
Semotilus atromaculatus	29	52.6	0.27	30	33.5

Station # 9 **Collection #:** JRS-00-60 **EPA #:** MT-59 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	12	77.3	0.21	12	14.1

Station # 10 **Collection #:** JRS-00-64 **EPA #:** MT-02 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	3	1.5	0.01	NA	

Station # 11 **Collection #:** JRS-00-65 **EPA #:** MT-03 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	3	11.4	0.04	NA	
Catostomus commersoni	1	11.3	0.04	NA	
Clinostomus funduloides	2	10.4	0.04	NA	
Etheostoma caeruleum	2	2.7	0.01	NA	
Etheostoma nigrum	2	2.8	0.01	NA	
Hypentelium nigricans	2	31.4	0.11	NA	
Lepomis cyanellus	3	10.4	0.04	NA	
Rhinichthys atratulus	1	1.2	0.00	NA	
Semotilus atromaculatus	11	90.1	0.31	NA	

Station # 12 **Collection #:** JRS-00-68 **EPA #:** MT-14 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	1	114.0	0.68	NA	
Campostoma anomalum	11	40.9	0.25	16	36.8
Catostomus commersoni	8	609.5	3.65	9	15
Ericymba buccata	2	3.8	0.02	NA	
Etheostoma caeruleum	24	15.8	0.09	27	34.8
Etheostoma flabellare	2	1.1	0.01	NA	
Etheostoma nigrum	4	2.2	0.01	4	5.7
Lepomis cyanellus	53	260.6	1.56	73	104.6
Luxilus chrysocephalus	4	7.3	0.04	4	5.7
Pimephales notatus	2	7.3	0.04	2	6.8
Rhinichthys atratulus	1	0.9	0.01	NA	
Semotilus atromaculatus	45	626.0	3.75	45	46.5

Station # 13 **Collection #:** JRS-00-69 **EPA #:** MT-51 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	1	3.1	0.01	NA	
Semotilus atromaculatus	5	41.8	0.15	NA	

Station # 14 **Collection #:** JRS-00-91 **EPA #:** NA **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	198	1,538.3	1.10	198	199.82
Catostomus commersoni	58	646.1	0.46	58	58.26
Ericymba buccata	171	369.1	0.26	209	240.2
Etheostoma blennioides	43	141.3	0.10	43	43.3
Etheostoma caeruleum	290	388.2	0.28	312	327.7
Hypentelium nigricans	46	2,207.6	1.58	46	47.153
Lepomis cyanellus	1	22.2	0.02	NA	
Luxilus chrysocephalus	1	14.8	0.01	NA	
Micropterus salmoides	2	22.1	0.02	NA	
Notropis ludibundus	360	814.9	0.58	378	390.7
Pimephales notatus	352	765.3	0.55	367	378.3
Rhinichthys atratulus	629	1,931.2	1.38	NA	
Semotilus atromaculatus	185	5,911.0	4.24	186	188.9

Station # 15 **Collection #:** JRS-99-70 **EPA #:** MT-55 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	10	176.5	0.46	10	11.4
Catostomus commersoni	15	71.0	0.19	17	24.1
Ericymba buccata	7	13.7	0.04	7	7.8
Etheostoma caeruleum	9	14.7	0.04	9	10.1
Hypentelium nigricans	35	278.4	0.73	36	39.4
Rhinichthys atratulus	231	492.0	1.29	252	268.3
Semotilus atromaculatus	73	1,177.9	3.10	84	98.4

Station # 16 **Collection #:** JRS-00-53 **EPA #:** MT-01 **EIS Class:** 4 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	64	189.3	0.49	64	65.31
Catostomus commersoni	28	7,422.1	19.36	28	28.8
Clinostomus funduloides	41	117.6	0.31	41	41.9
Ericymba buccata	17	33.1	0.09	17	17.8
Etheostoma caeruleum	8	10.0	0.03	8	9.8
Etheostoma flabellare	15	28.7	0.07	19	32.3
Etheostoma nigrum	9	8.8	0.02	9	10.1
Lampetra aepyptera	10	55.9	0.15	NA	
Lepomis cyanellus	8	152.3	0.40	NA	
Lepomis megalotis	1	24.4	0.06	NA	
Luxilus chrysocephalus	21	77.5	0.20	21	23.4
Moxostoma erythrurum	2	1,251.9	3.26	NA	
Pimephales notatus	15	27.0	0.07	15	15.9
Rhinichthys atratulus	77	115.4	0.30	77	78.1
Semotilus atromaculatus	122	430.7	1.12	125	130.1

Station # 17 **Collection #:** JRS-00-54 **EPA #:** NA **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	24	81.6	0.38	25	28.8
Clinostomus funduloides	1	9.8	0.05	NA	
Etheostoma blennioides	6	24.4	0.11	6	7.7
Etheostoma caeruleum	6	12.1	0.06	6	7.71
Lepomis cyanellus	31	164.6	0.76	31	49.6
Rhinichthys atratulus	1	2.4	0.01	NA	
Semotilus atromaculatus	13	129.2	0.60	13	13.2

Station # 18 **Collection #:** JRS-00-55 **EPA #:** MT-15 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	7	32.0	0.19	7	7.3
Catostomus commersoni	1	9.4	0.05	NA	
Lepomis cyanellus	16	158.2	0.92	18	25.1
Pimephales promelas	2	4.7	0.03	NA	
Rhinichthys atratulus	1	2.1	0.01	NA	
Semotilus atromaculatus	11	111.8	0.65	NA	

Station # 19 **Collection #:** JRS-00-57 **EPA #:** MT-07 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	36	107.0	0.20	37	40.9
Catostomus commersoni	1	209.9	0.39	NA	
Etheostoma blennioides	3	6.5	0.01	NA	
Etheostoma caeruleum	82	66.4	0.12	85	90.3
Etheostoma flabellare	24	35.0	0.07	26	31.9
Etheostoma nigrum	65	49.9	0.09	124	230.3
Etheostoma zonale	2	1.8	0.00	NA	
Hypentelium nigricans	7	285.4	0.53	NA	
Lampetra aepyptera	1	2.7	0.01	NA	
Lepomis cyanellus	30	132.9	0.25	NA	
Luxilus chrysocephalus	11	19.1	0.04	14	26.2
Pimephales notatus	13	19.3	0.04	14	19.3
Semotilus atromaculatus	16	83.9	0.16	17	21.2

Station # 20 **Collection #:** JRS-00-58 **EPA #:** MT-05 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	2	289.3	0.50	NA	
Campostoma anomalum	74	195.4	0.33	76	80.5
Catostomus commersoni	57	13,284.9	22.75	57	57.0
Ericymba buccata	26	79.1	0.14	NA	
Etheostoma blennioides	2	2.3	0.00	NA	
Etheostoma caeruleum	9	5.4	0.01	9	11.8
Etheostoma flabellare	15	35.7	0.06	15	17.5
Etheostoma nigrum	36	40.3	0.07	43	56.4
Etheostoma zonale	6	6.0	0.01	6	6.9
Hypentelium nigricans	1	86.3	0.15	NA	
Lampetra aepyptera	2	9.8	0.02	NA	
Lepomis cyanellus	24	143.7	0.25	31	47.9
Lepomis macrochirus	1	0.5	0.00	NA	
Lepomis megalotis	1	7.1	0.01	NA	
Luxilus chrysocephalus	45	298.2	0.51	53	66.6
Micropterus punctulatus	1	2.3	0.00	NA	
Moxostoma erythrurum	12	5,519.1	9.45	NA	
Percina caprodes	2	9.6	0.02	NA	
Pimephales notatus	16	79.3	0.14	16	17.2
Semotilus atromaculatus	26	324.5	0.56	26	27.9

Station # 21 **Collection #:** JRS-00-66 **EPA #:** MT-04 **EIS Class:** 4 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	34	135.4	0.33	34	34.9
Catostomus commersoni	3	127.3	0.31	NA	
Ericymba buccata	1	2.7	0.01	NA	
Etheostoma caeruleum	4	5.0	0.01	4	5.7
Etheostoma flabellare	2	3.9	0.01	NA	
Etheostoma nigrum	3	3.1	0.01	3	4.1
Hypentelium nigricans	4	366.5	0.90	NA	
Lampetra aepyptera	1	4.2	0.01	NA	
Lepomis cyanellus	12	75.7	0.19	12	13.2
Lepomis macrochirus	1	1.0	0.00	NA	
Luxilus chrysocephalus	18	254.4	0.62	18	18.1
Pimephales notatus	2	6.4	0.02	NA	
Rhinichthys atratulus	1	1.5	0.00	NA	
Semotilus atromaculatus	29	164.4	0.40	29	29.4

Station # 22F **Collection #:** JRS-99-76 **EPA #:** MT-23 **EIS Class:** 3 **Stream Order:**4

Species	**Number**	**Biomass (g)**	**g/m^2**	**Estimate**	**Upper CL**
Ameiurus natalis	1	45.6	0.08	NA	
Campostoma anomalum	145	383.6	0.67	149	154.7
Catostomus commersoni	5	22.7	0.04	NA	
Ericymba buccata	5	9.1	0.02	5	5.5
Etheostoma blennioides	37	61.5	0.11	37	38.8
Etheostoma caeruleum	114	64.9	0.11	124	135.3
Etheostoma nigrum	5	3.8	0.01	5	5.5
Etheostoma zonale	58	47.2	0.08	67	80.5
Hypentelium nigricans	9	148.7	0.26	9	10.6
Lepomis cyanellus	60	463.8	0.81	69	82.4
Lepomis macrochirus	3	12.8	0.02	NA	
Lepomis megalotis	1	33.2	0.06	NA	
Luxilus chrysocephalus	3	4.1	0.01	NA	
Micropterus punctulatus	1	101.0	0.18	NA	
Micropterus salmoides	1	15.4	0.03	NA	
Notropis ludibundus	21	24.5	0.04	27	42.8
Notropis photogenis	1	2.6	0.00	NA	
Notropis rubellus	4	6.5	0.01	4	4.6
Noturus miurus	1	0.0	0.00	NA	
Semotilus atromaculatus	36	202.2	0.35	36	37.1

Station # 22S **Collection #:** JRS-00-51 **EPA #:** MT-23 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	1	152.9	0.23	NA	
Ameiurus natalis	1	75.6	0.11	NA	
Campostoma anomalum	66	433.9	0.65	NA	
Catostomus commersoni	4	26.1	0.04	NA	
Ericymba buccata	28	58.7	0.09	NA	
Etheostoma blennioides	20	39.2	0.06	NA	
Etheostoma caeruleum	28	15.9	0.02	NA	
Etheostoma nigrum	1	1.0	0.00	NA	
Etheostoma zonale	16	13.2	0.02	NA	
Hypentelium nigricans	20	194.9	0.29	NA	
Lepomis cyanellus	16	128.9	0.19	NA	
Lepomis macrochirus	1	0.7	0.00	NA	
Luxilus chrysocephalus	27	152.7	0.23	40	71
Moxostoma erythrurum	1	5.4	0.01	NA	
Notropis ludibundus	62	86.7	0.13	NA	
Notropis rubellus	3	6.3	0.01	NA	
Percina caprodes	3	15.6	0.02	NA	
Percina maculata	1	1.8	0.00	NA	
Pimephales notatus	5	23.8	0.04	NA	
Semotilus atromaculatus	9	40.7	0.06	NA	

Station # 23 **Collection #:** JRS-00-56 **EPA #:**MT-17 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ameiurus natalis	1	81.4	0.16	NA	
Semotilus atromaculatus	9	9.2	0.02	NA	
Rhinichthys atratulus	3	1.3	0.00	NA	
Pimephales notatus	23	122.6	0.23	NA	
Percina caprodes	2	5.9	0.01	NA	
Notropis ludibundus	12	14.6	0.03	NA	
Moxostoma erythrurum	2	405.0	0.77	NA	
Micropterus salmoides	2	249.2	0.48	NA	
Lepomis megalotis	4	106.3	0.20	4	7.0
Ericymba buccata	6	9.2	0.02	NA	
Etheostoma blennioides	14	27.5	0.05	14	14.3
Etheostoma caeruleum	8	9.7	0.02	8	8.6
Etheostoma nigrum	6	6.7	0.01	6	9.5
Etheostoma zonale	4	3.5	0.01	NA	
Lepomis macrochirus	3	15.2	0.03	NA	
Lepomis cyanellus	83	541.8	1.03	105	131.4
Ambloplites rupestris	2	180.3	0.34	NA	
Hypentelium nigricans	8	164.8	0.31	8	8.7
Luxilus chrysocephalus	7	100.4	0.19	NA	

Table 2B. Total number caught (Number), total biomass (g), biomass per square meter (g/sq.m.), population estimate (based on 3-pass depletion), and the associated upper 95% confidence limit on the estimate (Upper CL) by species for fish collections completed in the Kanawha River Drainage (Spruce Fork and Clear Fork watersheds), West Virginia during Fall 1999 and Spring 2000. NA in the Estimate column indicates samples where an estimate could not be calculated due to too few fish being caught, an irregular depletion pattern, or all fish being caught in the first pass.

Station # 24 **Collection #:** JRS-00-92 **EPA #:** MT-42 **EIS Class:** 0 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
No Fish Caught					

Station # 25 **Collection #:** JRS-99-71 **EPA #:** MT-25B **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Lepomis cyanellus	1	2.8	0.01	NA	
Rhinichthys atratulus	7	16.3	0.05	7	7.8
Semotilus atromaculatus	59	478.1	1.45	59	60.6

Station # 26 **Collection #:** JRS-99-80 **EPA #:** MT-64 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Phoxinus erythrogaster	1	2.6	0.02	NA	
Rhinichthys atratulus	107	156.9	1.46	107	107.8
Semotilus atromaculatus	29	212.2	1.98	29	30.3

Station #27 **Collection #:** JRS-99-81 **EPA #:** MT-69 **EIS Class:** 4 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Cottus bairdi	130	224.8	1.68	152	173.2
Rhinichthys atratulus	9	23.3	0.17	9	10.1

Station # 28 **Collection #:** JRS-00-73 **EPA #:** MT-70 **EIS Class:** 3 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Cottus bairdi	88	264.7	1.75	103	120.7
Rhinichthys atratulus	14	43.4	0.29	14	15.4
Semotilus atromaculatus	7	64.4	0.43	NA	

Station # 29 **Collection #:** JRS-00-76 **EPA #:** MT-79 **EIS Class:** 1 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	11	28.9	0.42	11	11.2
Semotilus atromaculatus	6	86.0	1.25	6	6.4

Station # 30 **Collection #:** JRS-00-79 **EPA #:** MT-80 **EIS Class:** 1 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	4	3.6	0.04	4	4.6
Semotilus atromaculatus	1	1.8	0.02	NA	

Station # 31 **Collection #:** JRS-00-80 **EPA #:** MT-82 **EIS Class:** 1 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
No Fish Caught					

Station # 32 **Collection #:** JRS-00-93 **EPA #:** MT-39 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	20	20.6	0.20	NA	

Station # 33 **Collection #:** JRS-99-72 **EPA #:** MT-32 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	61	453.9	2.06	64	69.7
Catostomus commersoni	3	65.3	0.30	NA	
Cottus bairdi	1	1.5	0.01	NA	
Etheostoma caeruleum	18	44.6	0.20	18	19.1
Etheostoma nigrum	5	4.9	0.02	5	7.2
Hypentelium nigricans	4	10.8	0.05	4	5.7
Lepomis cyanellus	24	357.7	1.62	25	28.8
Lepomis macrochirus	32	52.6	0.24	32	34.1
Luxilus chrysocephalus	2	38.1	0.17	NA	
Micropterus salmoides	1	2.1	0.01	NA	
Notropis rubellus	1	1.7	0.01	NA	
Pimephales notatus	2	9.6	0.04	NA	
Rhinichthys atratulus	1	3.6	0.02	NA	
Semotilus atromaculatus	12	179.0	0.81	12	12.2

Station # 34 **Collection #:** JRS-99-73 **EPA #:** MT-45 **EIS Class:** 1 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	37	43.2	0.39	37	38
Semotilus atromaculatus	6	9.8	0.09	6	6.9

Station # 35 **Collection #:** JRS-99-78 **EPA #:** NA **EIS Class:** 1 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	6	49.9	0.18	6	6.4
Cottus bairdi	12	48.3	0.17	NA	
Etheostoma flabellare	32	30.9	0.11	34	39.4
Hypentelium nigricans	5	62.5	0.22	NA	
Rhinichthys atratulus	111	170.9	0.60	129	147.9
Semotilus atromaculatus	41	295.9	1.04	62	102.3

Station # 36 **Collection #:** JRS-99-79 **EPA #:** MT-62 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	5	148.1	0.70	5	6.2
Catostomus commersoni	1	265.0	1.25	NA	
Cottus bairdi	327	684.9	3.23	342	353.4
Etheostoma caeruleum	1	1.2	0.01	NA	
Hypentelium nigricans	7	472.1	2.23	7	7.8
Rhinichthys atratulus	44	71.7	0.34	46	50.7
*Salmo trutta**	3	NA	NA	NA	NA
Semotilus atromaculatus	35	250.2	1.18	61	121.2

* *Salmo trutta* were caught outside of the study site, measured (TL, mm), and released.

Station # 37 **Collection #:** JRS-99-82 **EPA #:** MT-70 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
No Fish Caught					

Station # 38 **Collection #:** JRS-00-70 **EPA #:** MT-28 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	18	155.2	0.38	18	19.4
Catostomus commersoni	19	172.0	0.42	19	19.5
Cottus bairdi	3	7.6	0.02	NA	
Hypentelium nigricans	6	420.4	1.04	NA	
Lepomis cyanellus	5	39.2	0.10	5	6.2
Lepomis macrochirus	16	23.5	0.06	25	26.5
Luxilus chrysocephalus	1	8.0	0.02	NA	
Rhinichthys atratulus	9	27.7	0.07	9	9.6
Semotilus atromaculatus	13	256.6	0.63	NA	

Station # 39 **Collection #:** JRS-00-74 **EPA #:** MT-63 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Cottus bairdi	200	931.8	4.19	214	226.3
Hypentelium nigricans	10	1,158.2	5.21	NA	
Rhinichthys atratulus	62	174.7	0.79	62	63.1
Semotilus atromaculatus	2	4.9	0.02	NA	

Station # 40 **Collection #:** JRS-00-77 **EPA #:** MT-85 **EIS Class:** 1 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	18	76.8	0.18	18	19.4
Semotilus atromaculatus	33	500.9	1.20	34	37.6

Station # 41 **Collection #:** JRS-00-78 **EPA #:** MT-81 **EIS Class:** 1 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	6	26.4	0.10	NA	
Semotilus atromaculatus	20	344.2	1.37	20	20.5

Station # 42 **Collection #:** JRS-99-74 **EPA #:** MT-40 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	28	73.1	0.05	28	30.3
Cottus bairdi	187	245.7	0.18	207	223.7
Cyprinus carpio	1	9.7	0.01	NA	
Etheostoma blennioides	1	4.5	0.00	NA	
Etheostoma caeruleum	87	95.5	0.07	110	137
Etheostoma zonale	13	13.7	0.01	NA	
Hypentelium nigricans	24	570.7	0.42	33	55.2
Luxilus chrysocephalus	3	2.8	0.00	NA	
Micropterus dolomieu	2	5.6	0.00	NA	
Notropis ludibundus	45	39.2	0.03	47	51.8
Notropis photogenis	2	5.3	0.00	NA	
Notropis rubellus	43	73.7	0.05	43	44.4
Rhinichthys atratulus	27	57.9	0.04	35	53
Semotilus atromaculatus	35	208.6	0.15	37	41.9

Station # 43 **Collection #:** JRS-00-71 **EPA #:** MT-46 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	2	419.6	0.34	NA	
Cottus bairdi	149	312.3	0.26	165	180.1
Etheostoma blennioides	7	32.6	0.03	7	9.9
Etheostoma caeruleum	160	183.6	0.15	175	188.8
Etheostoma zonale	4	5.7	0.00	NA	
Hypentelium nigricans	27	1,817.4	1.49	30	37.7
Luxilus chrysocephalus	30	784.3	0.64	31	34.4
Micropterus dolomieu	13	1,598.3	1.31	13	14.5
Notropis photogenis	23	64.1	0.05	24	27.6
Notropis rubellus	94	231.6	0.19	95	97.7
Notropis volucellus	1	1.2	0.00	NA	
Rhinichthys atratulus	4	4.5	0.00	4	4.6
Semotilus atromaculatus	13	238.0	0.20	13	15.4

Station # 44 **Collection #:** JRS-00-72 **EPA #:** MT-47 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	2	385.2	0.22	2	6.9
Campostoma anomalum	86	590.2	0.33	94	104.5
Cottus bairdi	79	168.1	0.09	NA	
Ericymba buccata	19	27.1	0.02	19	19.5
Etheostoma blennioides	2	9.1	0.01	NA	
Etheostoma caeruleum	74	72.7	0.04	NA	
Etheostoma zonale	1	0.9	0.00	NA	
Hypentelium nigricans	20	1,400.6	0.79	22	28.6
Lampetra aepyptera	1	1.3	0.00	NA	
Lepomis macrochirus	1	6.3	0.00	NA	
Luxilus chrysocephalus	47	1,195.3	0.67	58	75.9
Micropterus dolomieu	9	1,169.5	0.66	9	9.6
Moxostoma erythrurum	4	2,166.5	1.22	NA	
Notropis photogenis	10	20.9	0.01	10	10.2
Notropis rubellus	86	199.4	0.11	107	131.7
Notropis volucellus	12	12.7	0.01	NA	
Rhinichthys atratulus	12	18.7	0.01	12	12.8
Semotilus atromaculatus	23	275.1	0.15	27	37.4

Station # 45 **Collection #:** JRS-99-75 **EPA #:** MT-48 **EIS Class:** 3 **Stream Order:** 5

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	8	793.7	0.50	8	8.3
Campostoma anomalum	14	106.7	0.07	14	16.6
Cottus bairdi	6	21.8	0.01	NA	
Cyprinella spiloptera	1	3.0	0.00	NA	
Etheostoma blennioides	14	34.3	0.02	15	19.9
Etheostoma caeruleum	218	151.8	0.10	NA	
Etheostoma nigrum	15	10.8	0.01	18	27.9
Etheostoma variatum	9	38.1	0.02	NA	
Etheostoma zonale	22	19.4	0.01	27	39.9
Hypentelium nigricans	40	1,439.8	0.91	41	44.5
Lepomis cyanellus	1	10.8	0.01	NA	
Lepomis macrochirus	2	5.2	0.00	NA	
Luxilus chrysocephalus	19	71.6	0.05	22	30.9
Micropterus dolomieu	12	1,462.7	0.92	12	13.6
Notropis ludibundus	46	45.0	0.03	NA	
Notropis photogenis	8	18.6	0.01	8	10.5
Notropis rubellus	66	98.7	0.06	77	92.1
Pimephales notatus	4	15.1	0.01	NA	
Rhinichthys atratulus	1	0.2	0.00	NA	
Semotilus atromaculatus	1	25.5	0.02	NA	

Table 3B. Total number caught (Number), total biomass (g), biomass per square meter (g/sq.m.), population estimate (based on 3-pass depletion), and the associated upper 95% confidence limit on the estimate (Upper CL) by species for fish collections completed in the New River Drainage (Twentymile Creek watershed), West Virginia during Fall 1999 and Spring 2000. NA in the Estimate column indicates samples where an estimate could not be calculated due to too few fish being caught, an irregular depletion pattern, or all fish being caught in the first pass.

Station # 46 **Collection #:** JRS-00-88 **EPA #:** MT-93 **EIS Class:** 0 **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
No Fish Caught					

Station # 47 **Collection #:** JRS-99-86 **EPA #:** MT-98 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Catostomus commersoni	1	29.5	0.10	NA	
Rhinichthys atratulus	40	77.9	0.26	50	67.9
Semotilus atromaculatus	2	96.5	0.32	NA	

Station # 48 **Collection #:** JRS-00-83 **EPA #:** NA **EIS Class:** 1 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	13	150.3	0.32	13	14.5
Catostomus commersoni	8	93.2	0.20	NA	
Cottus bairdi	22	63.6	0.13	22	24.3
Etheostoma caeruleum	2	3.6	0.01	NA	
Etheostoma flabellare	69	113.1	0.24	80	95
Hypentelium nigricans	1	32.2	0.07	NA	
Rhinichthys atratulus	112	226.1	0.48	118	125.9
Semotilus atromaculatus	50	201.1	0.43	51	54.2

Station # 49 **Collection #:** JRS-00-84 **EPA #:** MT-87 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Etheostoma flabellare	5	8.1	0.03	NA	
Rhinichthys atratulus	72	116.0	0.49	74	78.3
Semotilus atromaculatus	12	41.5	0.18	12	13.6

Station # 50 **Collection #:** JRS-00-85 **EPA #:** MT-95 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	7	20.0	0.30	7	7.3
Cottus bairdi	1	0.8	0.01	NA	
Etheostoma caeruleum	38	25.9	0.39	38	40.2
Etheostoma flabellare	2	2.4	0.04	NA	
Semotilus atromaculatus	4	4.8	0.07	NA	

Station # 51 **Collection #:** JRS-00-86 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	25	140.2	1.44	25	26.8
Etheostoma caeruleum	17	8.5	0.09	17	18.8
Etheostoma flabellare	12	11.5	0.12	NA	
Etheostoma nigrum	1	4.0	0.04	NA	
Luxilus chrysocephalus	5	31.6	0.32	NA	
Semotilus atromaculatus	5	83.0	0.85	5	5.5

Station # 52 **Collection #:** JRS-00-87 **EPA #:** MT-91 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	1	18.6	0.06	NA	
Catostomus commersoni	4	79.3	0.27	NA	
Cottus bairdi	30	125.5	0.42	31	35.0
Etheostoma flabellare	28	51.9	0.17	29	32.9
Rhinichthys atratulus	89	175.1	0.59	89	91.1
Semotilus atromaculatus	31	113.9	0.38	31	31.4

Station # 53 **Collection #:** JRS-00-89 **EPA #:** MT-94 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Cottus bairdi	3	6.0	0.07	NA	
Rhinichthys atratulus	7	13.2	0.15	7	8.4
Semotilus atromaculatus	3	15.0	0.17	NA	

Station # 54 **Collection #:** JRS-99-84 **EPA #:** NA **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	15	952.5	0.74	15	16.6
Campostoma anomalum	27	216.8	0.17	31	40.7
Cyprinella galactura	18	135.9	0.11	18	19.7
Etheostoma blennioides	2	5.8	0.00	NA	
Etheostoma caeruleum	36	24.5	0.02	46	65.1
Etheostoma flabellare	5	8.0	0.01	NA	
Etheostoma nigrum	4	3.5	0.00	NA	
Hypentelium nigricans	13	632.3	0.49	13	14.4
Lepomis cyanellus	6	91.1	0.07	6	7.7
Luxilus albeolus	8	72.9	0.06	8	8.6
Luxilus chrysocephalus	1	21.7	0.02	NA	
Micropterus dolomieu	3	183.4	0.14	3	4.1
Nocomis platyrhynchus	46	1,112.8	0.87	50	57.6
Notropis rubellus	16	19.6	0.02	17	21.2
Notropis telescopus	75	97.2	0.08	82	92.1
Notropis volucellus	1	2.1	0.00	NA	
Pimephales notatus	3	8.0	0.01	NA	

Station # 55 **Collection #:** JRS-99-85 **EPA #:** NA **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	72	271.2	0.90	81	93.4
Etheostoma caeruleum	95	95.1	0.32	101	109.3
Etheostoma flabellare	8	12.8	0.04	8	9.8
Hypentelium nigricans	1	46.0	0.15	NA	
Lepomis cyanellus	11	202.7	0.67	NA	
Lepomis cyanellus x L.macrochirus	1	11.0	0.04	NA	
Nocomis platyrhynchus	72	281.9	0.94	74	78.3
Rhinichthys atratulus	46	50.8	0.17	51	59.9
Semotilus atromaculatus	21	69.4	0.23	27	42.8

Station # 56 **Collection #:** JRS-00-81 **EPA #:** MT-86 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Catostomus commersoni	11	296.2	1.00	NA	
Cottus bairdi	3	16.2	0.05	3	4.1
Etheostoma caeruleum	1	1.1	0.00	NA	
Etheostoma flabellare	24	31.6	0.11	29	41.3
Rhinichthys atratulus	70	144.2	0.49	71	74.2
Semotilus atromaculatus	40	265.5	0.89	42	46.9

Station # 57 **Collection #:** JRS-00-82 **EPA #:** NA **EIS Class:** 2 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	17	192.1	0.19	20	29.3
Catostomus commersoni	15	372.9	0.36	15	17.4
Cottus bairdi	21	86.5	0.08	22	25.9
Etheostoma caeruleum	18	29.4	0.03	19	23.2
Etheostoma flabellare	23	48.0	0.05	NA	
Hypentelium nigricans	10	750.2	0.72	10	12.5
Luxilus albeolus	12	114.2	0.11	12	14.1
Rhinichthys atratulus	69	152.2	0.15	107	163
Semotilus atromaculatus	53	629.5	0.61	76	113.1

Station # 58 **Collection #:** JRS-99-83 **EPA #:** NA **EIS Class:** 2 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	17	735.6	0.92	19	25.7
Campostoma anomalum	63	343.7	0.43	65	69.7
Catostomus commersoni	4	246.2	0.31	4	5.7
Cottus bairdi	2	5.0	0.01	NA	
Ericymba buccata	7	18.3	0.02	NA	
Etheostoma caeruleum	31	22.9	0.03	32	35.9
Etheostoma flabellare	2	0.8	0.00	NA	
Etheostoma nigrum	9	10.0	0.01	9	9.6
Hypentelium nigricans	20	351.7	0.44	27	46.3
Lepomis cyanellus	11	154.7	0.19	NA	
Luxilus albeolus	30	160.0	0.20	31	34.7
Micropterus dolomieu	7	125.8	0.16	7	8.4
Nocomis platyrhynchus	15	79.4	0.10	15	16.3
Notropis telescopus	3	9.4	0.01	NA	
Pimephales notatus	1	2.4	0.00	NA	
Semotilus atromaculatus	26	298.9	0.37	26	26.4

Table 4B. Total number caught (Number), total biomass (g), biomass per square meter (g/sq.m.), population estimate (based on 3-pass depletion), and the associated upper 95% confidence limit on the estimate (Upper CL) by species for fish collections completed in the Cumberland, Kentucky, and North Fork of the Kentucky River Drainages, Kentucky during Spring 2000. NA in the Estimate column indicates samples where an estimate could not be calculated due to too few fish being caught, an irregular depletion pattern, or all fish being caught in the first pass.

Station # 59 **Collection #:** JRS-00-95 **EPA #:** 8 **EIS Class:** 2 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	26	2,011.2	1.49	33	49.1
Campostoma anomalum	94	570.8	0.42	128	167.5
Etheostoma baileye	4	2.7	0.00	NA	
Etheostoma caeruleum	115	89.8	0.07	240	421.9
Etheostoma flabellare	32	22.9	0.02	33	36.8
Etheostoma kennicotti	7	6.2	0.00	NA	
Hypentelium nigricans	30	1,085.3	0.80	43	71.8
Lepomis auritus	39	1,361.7	1.01	73	151.8
Luxilus chrysocephalus	25	235.3	0.17	29	39.0
Micropterus dolomieu	6	141.3	0.10	NA	
Micropterus punctulatus	11	456.5	0.34	NA	
Notropis rubellus	3	5.4	0.00	NA	
Pimephales notatus	37	68.6	0.05	NA	
Semotilus atromaculatus	1	3.7	0.00	NA	

Station # 60 **Collection #:** JRS-00-96 **EPA #:** 6 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	154	1,178.6	3.12	155	157.7
Etheostoma caeruleum	121	167.6	0.44	131	142.0
Etheostoma flabellare	16	18.9	0.05	16	17.5
Hypentelium nigricans	7	119.0	0.32	7	7.3
Pimephales notatus	1	1.8	0.00	NA	
Rhinichthys atratulus	276	444.7	1.18	288	298.0
Semotilus atromaculatus	306	1,045.5	2.77	314	321.8

Station # 61 **Collection #:** JRS-00-97 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	3	11.7	0.01	3	4.1
Campostoma anomalum	8	47.7	0.05	8	9.8
Etheostoma baileye	3	2.2	0.00	NA	
Etheostoma blennioides	1	4.6	0.00	NA	
Etheostoma caeruleum	88	71.1	0.07	96	106.5
Etheostoma kennicotti	20	14.7	0.01	20	20.3
Hypentelium nigricans	15	1,408.2	1.37	NA	
Lepomis auritus	148	3,985.2	3.88	192	231.4
Lepomis macrochirus	88	1,350.7	1.31	110	135.7
Luxilus chrysocephalus	4	14.2	0.01	4	7.1
Lythrurus ardens	5	4.6	0.00	5	5.5
Micropterus punctulatus	2	188.2	0.18	NA	
Notropis rubellus	1	0.5	0.00	NA	
Phoxinus erythrogaster	1	2.9	0.00	NA	
Pimephales notatus	83	113.5	0.11	93	105.6
Semotilus atromaculatus	24	149.3	0.15	25	28.8

Station # 62 **Collection #:** JRS-00-94 **EPA #:** 12 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	4	113.8	0.27	NA	
Campostoma anomalum	100	180.3	0.43	101	104.1
Catostomus commersoni	1	0.1	0.00	NA	
Etheostoma baileye	11	8.6	0.02	11	13.8
Etheostoma blennioides	50	75.9	0.18	52	56.4
Etheostoma caeruleum	196	139.8	0.33	199	203.6
Etheostoma flabellare	91	102.6	0.24	92	95
Etheostoma nigrum	23	10.7	0.03	24	27.6
Etheostoma sagitta	1	1.6	0.00	NA	
Hypentelium nigricans	13	133.3	0.31	13	13.5
Lepomis megalotis	1	30.0	0.07	NA	
Luxilus chrysocephalus	125	272.4	0.64	129	134.8
Lythrurus ardens	35	31.4	0.07	35	36.5
Micropterus dolomieu	1	266.0	0.63	NA	
Moxostoma erythrurum	3	706.0	1.67	NA	
Oncorhynchus mykiss	1	81.0	0.19	NA	
Percina maculata	10	18.7	0.04	10	11.4
Percina stictogaster	6	8.9	0.02	6	7.7
Pimephales notatus	68	71.2	0.17	71	76.3
Semotilus atromaculatus	44	101.7	0.24	47	53.1

Station # 63 **Collection #:** JRS-00-98 **EPA #:** 13 **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	41	122.1	0.53	41	42.6
Ericymba buccata	2	5.1	0.02	NA	
Etheostoma baileye	21	12.5	0.05	21	22.1
Etheostoma blennioides	59	72.8	0.31	61	65.8
Etheostoma caeruleum	97	63.2	0.27	109	122.8
Etheostoma flabellare	59	44.4	0.19	65	74.6
Etheostoma nigrum	64	27.8	0.12	70	79.3
Luxilus chrysocephalus	6	8.9	0.04	6	6.9
Percina stictogaster	5	5.0	0.02	5	6.2
Phoxinus erythrogaster	108	54.3	0.23	111	116.0
Pimephales notatus	2	1.9	0.01	NA	
Semotilus atromaculatus	95	273.2	1.18	97	101.0

Station # 64 **Collection #:** JRS-00-99 **EPA #:** 3 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	5	29.4	0.17	NA	
Catostomus commersoni	4	62.3	0.36	NA	
Etheostoma flabellare	5	5.5	0.03	NA	
Hypentelium nigricans	1	10.9	0.06	NA	
Lepomis cyanellus	3	5.5	0.03	NA	
Luxilus chrysocephalus	1	3.6	0.02	NA	
Moxostoma erythrurum	1	7.1	0.04	NA	
Pimephales notatus	6	9.7	0.06	NA	
Rhinichthys atratulus	35	75.1	0.43	39	47.5
Semotilus atromaculatus	30	235.4	1.35	40	61.6

Station # 65 **Collection #:** JRS-00-100 **EPA #:** 2 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	1	5.1	0.02	NA	
Etheostoma caeruleum	119	144.2	0.48	120	123.1
Hypentelium nigricans	6	57.1	0.19	6	6.9
Lepomis macrochirus	1	1.7	0.01	NA	
Rhinichthys atratulus	294	610.8	2.05	295	297.4
Semotilus atromaculatus	93	294.9	0.99	98	105.1

Station # 66 **Collection #:** JRS-00-101 **EPA #:** 9 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	32	99.3	0.12	32	34.1
Catostomus commersoni	2	14.1	0.02	NA	
Etheostoma baileye	3	2.6	0.00	3	4.1
Etheostoma blennioides	3	3.7	0.00	NA	
Etheostoma caeruleum	116	65.5	0.08	150	184.6
Hypentelium nigricans	25	246.1	0.30	25	25.4
Lepomis hybrid	1	7.4	0.01	NA	
Luxilus chrysocephalus	15	48.7	0.06	15	15.9
Micropterus dolomieu	1	3.0	0.00	NA	
Notropis ludibundus	1	1.3	0.00	NA	
Notropis rubellus	1	1.5	0.00	NA	
Pimephales notatus	1	2.1	0.00	NA	
Semotilus atromaculatus	80	304.6	0.37	85	92.4

Station # 67 **Collection #:** JRS-00-102 **EPA #:** 14 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	1	11.2	0.04	NA	
Lepomis macrochirus	1	45.4	0.16	NA	
Rhinichthys atratulus	2	7.9	0.03	NA	
Semotilus atromaculatus	90	285.3	1.01	125	166.9

Station # 68 **Collection #:** JRS-00-103 **EPA #:** 5 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	1	8.3	0.08	NA	
Campostoma anomalum	7	8.3	0.08	7	7.8
Etheostoma baileye	1	0.4	0.00	NA	
Etheostoma blennioides	5	6.7	0.06	5	6.2
Etheostoma caeruleum	7	3.6	0.03	7	8.4
Etheostoma variatum	1	0.6	0.01	NA	
Hypentelium nigricans	2	15.8	0.15	NA	
Luxilus chrysocephalus	76	113.2	1.10	76	76.2
Nocomis micropogon	1	4.0	0.04	NA	
Noturus miurus	1	4.0	0.04	NA	
Pimephales notatus	1	1.4	0.01	NA	
Semotilus atromaculatus	9	66.8	0.65	9	11.2

Station # 69 **Collection #:** JRS-00-104 **EPA #:** 4 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ameiurus natalis	2	65.9	0.21	NA	
Campostoma anomalum	15	51.4	0.16	16	20.5
Catostomus commersoni	1	8.4	0.03	NA	
Etheostoma baileye	5	3.8	0.01	5	6.2
Etheostoma blennioides	3	8.3	0.03	NA	
Etheostoma caeruleum	9	7.5	0.02	9	10.6
Etheostoma variatum	1	5.4	0.02	NA	
Lepomis cyanellus	3	22.2	0.07	NA	
Lepomis macrochirus	6	60.6	0.19	6	6.4
Luxilus chrysocephalus	39	120.0	0.38	40	43.4
Notropis rubellus	3	4.2	0.01	NA	
Pimephales notatus	4	11.1	0.04	NA	
Rhinichthys atratulus	2	2.4	0.01	NA	
Semotilus atromaculatus	28	235.8	0.74	28	29.1

Station # 70 **Collection #:** JRS-00-105 **EPA #:** 1 **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Hypentelium nigricans	1	38.2	0.27	NA	
Semotilus atromaculatus	22	153.9	1.10	NA	

Station # 71 **Collection #:** JRS-00-106 **EPA #:** 10 **EIS Class:** 0 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	93	295.0	1.40	93	94.7
Ericymba buccata	44	52.5	0.25	44	45.5
Etheostoma baileye	60	53.5	0.25	60	61.0
Etheostoma blennioides	19	34.3	0.16	19	19.7
Etheostoma caeruleum	75	66.6	0.32	75	75.5
Etheostoma flabellare	85	69.5	0.33	86	88.6
Etheostoma nigrum	124	52.1	0.25	127	132.1
Etheostoma sagitta	1	3.3	0.02	NA	
Hypentelium nigricans	4	30.2	0.14	4	4.6
Luxilus chrysocephalus	47	132.1	0.63	NA	
Percina maculata	1	2.1	0.01	NA	
Semotilus atromaculatus	101	414.6	1.96	102	104.8

Station # 72 **Collection #:** JRS-00-107 **EPA #:** 11 **EIS Class:** 0 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	113	131.1	1.12	113	113.6
Etheostoma baileye	7	3.9	0.03	7	7.8
Etheostoma blennioides	7	8.8	0.07	7	8.4
Etheostoma caeruleum	20	12.1	0.10	20	20.9
Etheostoma flabellare	3	4.6	0.04	NA	
Etheostoma nigrum	2	1.0	0.01	NA	
Luxilus chrysocephalus	12	32.4	0.28	12	12.4
Percina maculata	2	2.7	0.02	NA	
Semotilus atromaculatus	54	204.7	1.74	55	58.2

Station # 73 **Collection #:** JRS-00-108 **EPA #:** 7 **EIS Class:** 2 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	3	0.9	0.00		
Catostomus commersoni	19	5.1	0.01	23	34.5
Etheostoma blennioides	1	1.5	0.00	NA	
Hypentelium nigricans	6	0.6	0.00	NA	
Lampetra aepyptera	2	3.9	0.01	NA	
Pimephales notatus	3	10.4	0.02	NA	
Semotilus atromaculatus	42	91.7	0.22	42	43.4

APPENDIX C. Total number caught (Number), total biomass (g), biomass per square meter (g/sq.m.), population estimate (based on 3-pass depletion), and the associated upper 95% confidence limit on the estimate (Upper CL) by species for fish collections completed in the Guyandotte River Drainage (Mud River, Big Ugly, and Buffalo Creek watersheds) in Fall 2001. NA in the Estimate column indicates samples where an estimate could not be calculated due to too few fish being caught, an irregular depletion pattern, or all fish being caught in the first pass.

Station # 7 **Collection #:** JRS-01-84 **EPA #:** MT-18 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Lepomis cyanellus	6	59	0.351	NA	
Semotilus atromaculatus	3	40	0.930	NA	

Station # 12 **Collection #:** JRS-01-87 **EPA #:** MT-14 **EIS Class:** 2 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	2	6	0.037	NA	
Catostomus commersoni	2	25	0.155	NA	
Etheostoma caeruleum	1	1	0.006	NA	
Lepomis cyanellus	2	20	0.124	NA	
Pimephales notatus	1	6	0.037	NA	
Semotilus atromaculatus	13	304	1.882	NA	

Station # 17 **Collection #:** JRS-01-85 **EPA #:** NA **EIS Class:** 2 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ameiurus melas	1	157	0.561	NA	
Campostoma anomalum	1	12	0.043	NA	
Catostomus commersoni	2	10	0.036	NA	
Etheostoma blennioides	1	5	0.018	NA	
Etheostoma caeruleum	1	1	0.004	NA	
Lepomis cyanellus	12	92	0.329	12	14.1
Lepomis macrochirus	1	7	0.025	NA	
Pimephales promelas	2	4	0.014	4	5.7
Semotilus atromaculatus	11	259	0.925	12	17.6

Station # 18	**Collection #:** JRS-01-86	**EPA #:** MT-15	**EIS Class:** 2	**Stream Order:** 3	
Species	**Number**	**Biomass (g)**	**g/m²**	**Estimate**	**Upper CL**
Ameiurus nebulosus	1	83	0.638	NA	
Campostoma anomalum	1	2	0.015	NA	
Hypentelium nigricans	1	44	0.338	NA	
Lepomis cyanellus	12	155	1.192	12	14.1
Pimephales promelas	3	8	0.062	NA	
Semotilus atromaculatus	2	46	0.354	NA	

Station # 19	**Collection #:** JRS-01-88	**EPA #:** MT-07	**EIS Class:** 3	**Stream Order:** 3	
Species	**Number**	**Biomass (g)**	**g/m²**	**Estimate**	**Upper CL**
Ericymba bucatta	1	3	0.006	NA	
Etheostoma caeruleum	10	9	0.018	10	10.9
Etheostoma flabellare	12	10	0.020	12	13.2
Etheostoma nigrum	5	3	0.006	NA	
Lepomis cyanellus	22	91	0.181	23	26.8
Pimephales notatus	1	1	0.002	NA	
Rhinichthys atratulus	6	13	0.026	6	7.0
Semotilus atromaculatus	50	201	0.399	51	54.0

Station # 20 **Collection #:** JRS-01-89 **EPA #:** MT-05 **EIS Class:** 3 **Stream Order:** 3

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	11	48	0.135	11	12.8
Catostomus commersoni	13	201	0.565	13	15.4
Clinostomus funduloides	2	8	0.022	NA	
Ericymba buccata	8	21	0.059	8	10.5
Etheostoma caeruleum	4	5	0.014	4	5.7
Etheostoma flabellare	16	21	0.059	16	16.9
Etheostoma nigrum	10	10	0.028	10	11.4
Labidesthes sicculus	16	22	0.062	16	18.3
Lampetra aepyptera	2	3	0.008	NA	
Lepomis cyanellus	38	301	0.846	NA	
Lepomis macrochirus	1	4	0.011	NA	
Lepomis megalotis	1	14	0.039	NA	
Luxilus chrysocephalus	1	10	0.028	NA	
Micropterus punctulatus	3	6	0.017	3	4.1
Percina caprodes	3	9	0.025	3	4.1
Pimephales notatus	4	10	0.028	4	4.7
Rhinichthys atratulus	3	8	0.022	3	4.1
Semotilus atromaculatus	115	911	2.559	127	140.2

Station # 22 **Collection #:** JRS-01-82 **EPA #:** MT-23 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ameiurus natalis	1	272	0.389	NA	
Campostoma anomalum	29	193	0.276	29	29.2
Etheostoma blennioides	10	20	0.029	10	10.2
Etheostoma caeruleum	22	16	0.023	23	27.2
Etheostoma nigrum	2	1	0.001	NA	
Etheostoma zonale	10	10	0.014	12	21.2
Hypentelium nigricans	2	89	0.127	NA	
Lepomis cyanellus	16	291	0.416	17	21.2
Luxilus chrysocephalus	1	4	0.006	NA	
Micropterus punctulatus	1	314	0.449	NA	
Notropis ludibundus	1	2	0.003	NA	
Semotilus atromaculatus	12	78	0.111	12	12.8

Station # 23 **Collection #:** JRS-01-83 **EPA #:** MT-17 **EIS Class:** 3 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	1	113	0.232	NA	
Ameiurus natalis	2	392	0.804	NA	
Campostoma anomalum	1	8	0.016	NA	
Catostomus commersoni	2	107	0.219	NA	
Lepomis macrochirus	1	8	0.016	NA	
Lepomis megalotis	17	300	0.615	19	25.7
Luxilus chrysocephalus	1	39	0.080	NA	
Semotilus atromaculatus	4	283	0.581	4	7.1

Station # 74 **Collection #:** JRS-01-90 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	1	41	0.045	NA	
Campostoma anomalum	11	13	0.014	11	12.3
Cyprinella spiloptera	11	20	0.022	11	11.2
Ericymba buccata	29	29	0.032	34	45.0
Etheostoma blennioides	7	12	0.013	7	7.3
Etheostoma caeruleum	22	13	0.014	22	22.1
Etheostoma flabellare	11	10	0.011	11	11.5
Etheostoma nigrum	84	40	0.044	84	86.0
Etheostoma variatum	4	7	0.008	NA	
Etheostoma zonale	5	3	0.003	NA	
Hypentelium nigricans	9	454	0.501	NA	
Lampetra aepyptera	30	127	0.140	31	35.0
Lepomis macrochirus	4	46	0.051	NA	
Lepomis megalotis	19	216	0.238	19	21.0
Luxilus chrysocephalus	81	230	0.254	82	84.9
Micropterus dolomieu	1	1	0.001	NA	
Micropterus punctulatus	19	315	0.347	19	20.3
Moxostoma erythrurum	17	423	0.467	17	18.1
Notropis ludibundus	2	3	0.003	NA	
Notropis rubellus	4	8	0.009	4	4.7
Noturus miurus	4	3	0.003	4	5.7
Percina maculata	3	4	0.004	NA	
Pimephales notatus	80	114	0.126	96	115.8
Semotilus atromaculatus	46	126	0.139	48	52.5

Station # 75 **Collection #:** JRS-01-91 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 4

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Ambloplites rupestris	2	2	0.003	NA	
Campostoma anomalum	56	110	0.143	56	57.5
Ericymba buccata	16	24	0.031	25	55.2
Etheostoma blennioides	26	38	0.050	29	36.6
Etheostoma caeruleum	77	33	0.043	81	87.5
Etheostoma flabellare	15	14	0.018	15	16.3
Etheostoma nigrum	89	45	0.059	100	113.4
Etheostoma variatum	14	47	0.061	14	15.4
Etheostoma zonale	16	7	0.009	17	21.2
Hypentelium nigricans	24	348	0.454	25	28.9
Lampetra aepyptera	4	7	0.009	4	4.7
Lepomis gibbosus	3	28	0.037	NA	
Lepomis megalotis	12	129	0.168	13	18.1
Luxilus chrysocephalus	207	809	1.055	250	282.0
Micropterus dolomieu	4	9	0.012	NA	
Micropterus punctulatus	4	58	0.076	4	5.7
Notropis ludibundus	14	20	0.026	16	23.6
Notropis rubellus	3	5	0.007	NA	
Percina maculata	4	5	0.007	NA	
Pimephales notatus	174	271	0.353	198	218.0
Semotilus atromaculatus	54	340	0.443	97	178.1

Station # 76 **Collection #:** JRS-01-92 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	13	52	0.452	13	13.4
Ericymba buccata	23	34	0.296	23	23.1
Etheostoma caeruleum	30	29	0.252	30	31.3
Etheostoma flabellare	5	7	0.061	NA	
Etheostoma nigrum	2	2	0.017	NA	
Lepomis megalotis	2	16	0.139	NA	
Luxulus chrysocephalus	9	11	0.096	NA	
Micropterus dolomeiu	2	4	0.035	NA	
Percina maculatum	2	4	0.035	NA	
Pimephales notatus	4	11	0.096	NA	
Rhinichthys atratulus	29	46	0.400	29	29.3
Semotilus atromaculatus	50	234	2.035	50	52.1

Station # 77 **Collection #:** JRS-01-93 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 2

Species	**Number**	**Biomass (g)**	**g/m^2**	**Estimate**	**Upper CL**
Campostoma anomalum	3	11	0.099	3	4.1
Catostomus commersoni	2	19	0.171	NA	
Clinostomus funduloides	5	8	0.072	5	5.5
Ericymba buccata	17	32	0.289	17	17.8
Etheostoma caeruleum	24	22	0.198	24	25.3
Etheostoma flabellare	5	8	0.072	5	5.5
Etheostoma nigrum	5	3	0.027	5	5.5
Hypentelium nigricans	1	16	0.144	NA	
Lampetra aepyptera	1	2	0.018	NA	
Luxilus chrysocephalus	2	9	0.081	NA	
Pimephales notatus	5	14	0.126	5	5.5
Rhinichthys atratulus	18	18	0.162	18	19.7
Semotilus atromaculatus	57	300	2.707	57	59.2

Station # 78 **Collection #:** JRS-01-94 **EPA #:** NA **EIS Class:** 0 **Stream Order:** 3

Species	**Number**	**Biomass (g)**	**g/m^2**	**Estimate**	**Upper CL**
Ambloplites rupestris	7	7	0.021	7	7.3
Campostoma anomalum	29	92	0.270	29	29.1
Ericymba buccata	50	79	0.232	50	50.2
Etheostoma blennioides	5	9	0.026	5	5.5
Etheostoma caeruleum	144	91	0.267	146	149.7
Etheostoma flabellare	14	13	0.038	14	14.4
Etheostoma nigrum	36	19	0.056	36	37.1
Etheostoma variatum	6	28	0.082	NA	
Hypentelium nigricans	7	176	0.517	7	8.4
Lampetra aepyptera	4	16	0.047	4	7.1
Lepomis megalotis	23	339	0.995	23	24.1
Luxilus chrysocephalus	47	94	0.276	47	47.2
Micropterus dolomieu	5	111	0.326	5	6.2
Percina maculata	6	10	0.029	6	6.4
Pimephales notatus	66	53	0.156	69	74.5
Rhinichthys atratulus	2	2	0.006	NA	
Semotilus atromaculatus	74	215	0.631	74	74.4

Station # 79 **Collection #:** JRS-01-95 **EPA #:** NA **EIS Class:** ? **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Campostoma anomalum	154	711	2.045	157	162.0
Catostomus commersoni	25	320	0.920	25	26.0
Ericymba buccata	21	59	0.170	21	21.1
Hypentelium nigricans	4	41	0.118	NA	
Pimephales notatus	9	42	0.121	9	9.2
Rhinichthys atratulus	141	224	0.644	141	141.8
Semotilus atromaculatus	314	2294	6.598	344	348.6

Station # 80 **Collection #:** JRS-01-96 **EPA #:** NA **EIS Class:** ? **Stream Order:** 1

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	92	135	1.753	92	92.4
Semotilus atromaculatus	52	220	2.857	52	52.1

Station # 81 **Collection #:** JRS-01-97 **EPA #:** NA **EIS Class:** ? **Stream Order:** 2

Species	Number	Biomass (g)	g/m^2	Estimate	Upper CL
Rhinichthys atratulus	38	72	0.608	38	38.1
Semotilus atromaculatus	40	69	0.583	40	40.1

APPENDIX D. Laboratory data sheets for chemical analysis conducted by Research Environmental & Industrial Consultants, Inc (REIC) for water samples collected at the 16 sites sampled for fishes (Table 10) in the Mud River, Big Ugly, and Guyandotte drainages that were sampled in September 2001. A single water sample was collected at each site (according to directions provided by the EPA) and sent to the REIC for laboratory analysis of total metals (mg/L of aluminum, iron, arsenic, copper, and selenium) and hardness (as mg/L $CaCO_3$).